JUNE 18, 1990
CHEMICAL & ENGINEERING
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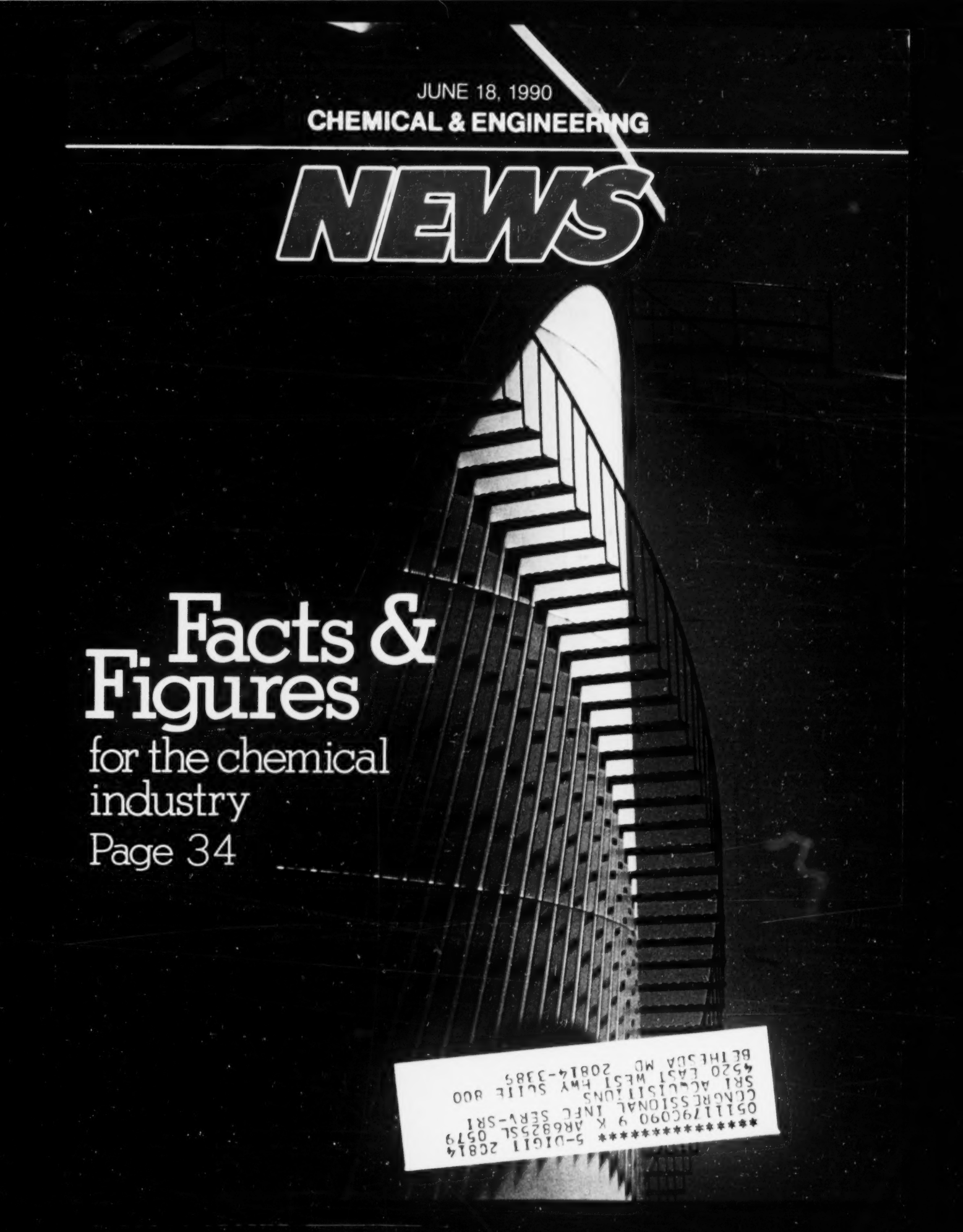

Facts & Figures

for the chemical industry

Page 34

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CHEMICAL & ENGINEERING
NEWS
JUNE 18, 1990

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News of the Week

- **Dialog Information Services files $150 million antitrust suit alleging ACS is using its "monopoly" over Chemical Abstracts Service's chemical information databases to seek control of on-line markets.** **Page 4**
- **Cold fusion continues to gather controversy as University of Utah president resigns under faculty pressure and university begins financial and scientific probe of its cold fusion research institute.** **Page 5**
- **Du Pont announces it is ending production of its acrylic fiber, Orlon.** **Page 5**
- **EPA issues rules controlling smog-forming volatile organic compound emissions from new synthetic organics plants and hazardous waste facilities.** **Page 6**

Business

Chemical production in Western Europe will likely grow a moderate 2.5% this year, according to CEFIC, slightly below the 3% rise expected in both gross domestic product and all manufacturing. **Page 9**

Supply of acrylic esters will continue to be tight, concludes a recent report by chemical market research firm. **Page 13**

Government

Environmental improvement over past 20 years is documented in 20th annual report issued by the President's Council on Environmental Quality. **Page 15**

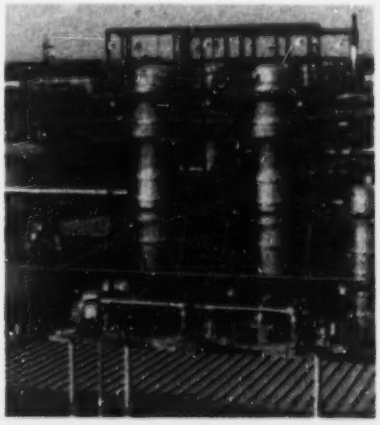
Science/Technology

The role of management in chemical process safety issues is coming under consideration now that technical safety applications are well established. **Page 19**

Books

"Biotechnology in Japan" by Malcolm V. Brock touts that country's centralized, goal-oriented strategy toward development by government, academia, and industry. **Page 84**

Cover: Uniphoto Picture Agency/ The Photographers' Library



Facts & Figures

C&EN's annual statistical survey of the chemical industry, both in the U.S. and abroad, shows continued growth for production in 1989, but at a slower pace than before. Producers' profits, meanwhile, came under pressure as demand slackened in some major markets. **Page 34**

Letters 2

Concentrates

Business 7
Government 14
Science/Technology 18

The Departments

Software/Database Update 27
ACS News 86
Newscripts 100

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LETTERS

CHEMICAL SAFETY

Solvent extraction hazard

SIR: In his letter (C&EN, April 30, page 2) Ray E. Kelling describes the explosion of a 2-L separatory funnel this way: To a 1-L sample of well water acidified to pH 2 with phosphoric acid, 60 mL methylene chloride was added. Then the stopper was inserted, and before venting could be done the funnel exploded when it was inverted.

I am a chemist who has performed extractions like this one hundreds of times over a six-year period. Once, I had a similar experience because of a weak spot in the separatory funnel. To avoid explosions like this, I recommend three safety precautions: (1) Inspect the separatory funnel for weak spots or cracks before using it. (2) Use refrigerated acid for pH adjustment to avoid heating the sample. (3) Prerinse the funnel with methylene chloride before adding the sample to the funnel. This avoids excess pressure buildup when the 60 mL methylene chloride is added and the stopper is inserted.

Dean W. Gibbons
Analytical Laboratory
Detroit Wastewater Treatment Plant

Teaching science

SIR: This letter is a response to those of Lewis Schupp, Dana Chatellier, and Thomas Collet (C&EN, March 5, page 3). Each of these writers makes some valid points.

I am a Ph.D. physical chemist with what were common minors in the 1950s: physics and math. All I ever wanted to do was teach, and the Ph.D. was the union card. My degree was awarded in absentia the day my third child was a week old, so it was several years before I looked for a job. It turned out that what was available was an opportunity to teach general physics at the university where my husband was professor of chemistry. I have been teaching now for nearly 30 years—first elementary school science on educational television along with college physics, then for the past 20 years a physical science course designed to give elementary education majors a broad background, including laboratory experience, for teaching science and to promote science literacy among the business and liberal arts students. I teach a kids' science class on Saturday mornings, work in Olympiads and science fairs, visit schools with demonstrations, and am generally on call to promote the teaching and learning of science whenever I can.

As a result of my choice to teach, I will never be highly paid. I will never make full professor. Perhaps, I will have encouraged a few youngsters to become scientists and created a little bit of understanding of what scientists do on the part of the general public. I am happy with my choice.

However, it is neither fair nor reasonable to expect that generation after generation of teachers and scientists will choose their jobs solely for love when people whose contribution to society is much less important are much better paid. I agree with Collet that the situation must change, but I don't have any quick fixes. A recent letter to the British weekly *New Scientist* sheds some light on the problem, I think. The writer points out that although children enjoy science demonstrations and lessons, they do not identify with the scientists who present them. When they are asked what career they would choose, they opt for commoner things—from fireman to hairdresser to secretary to salesperson—not for following in the footsteps of the oddball who did the science demo. The letter writer comments that we must find ways to present science to youngsters as a useful and challenging career for ordinary people.

Schupp has some good ideas about how to do that, but they would be prohibitively expensive for most school systems to initiate. There may be alternate approaches, and I would like to suggest a few.

- Make the most of local institutions. Some school systems in cities that have museums have developed innovative curricula that make the most of the local museum's resources, whether by taking the children to the museum or bringing the museum's exhibits and personnel to the schools.
- Involve prospective employers. As science-based industries become more aware of the shortage of trained workers at every level, they will be more receptive to requests for funding well-designed programs administered either by schools or by community organizations. IBM is already investing both money and people in a big way in "Operation Smart," a Girls Clubs program aimed to interest girls who might not

CEFIC Expects Moderate Growth in Chemicals in West Europe This Year

Although destocking is slowing production, chemical growth will lag only slightly a 3% rise in both gross domestic product, all manufacturing

Patricia L. Layman, C&EN London

Growth in production in the chemical industry in Western Europe will likely be about 2.5% this year over 1989, predicted the European Chemical Industry Federation (CEFIC) at its annual meeting two weeks ago in Paris. That is only slightly lower than the expected increase of 3% in both gross domestic product and all manufacturing production.

Production slowed considerably in the second half of 1989 because of destocking, as companies ran down inventories. CEFIC analysts assume that further destocking will continue during the first half of 1990, as a result of low prices. Producer price increases will probably be below the rate of general inflation, reflecting the strong competition in the European chemical industry and the fact that prices for oil and other raw materials are expected to rise only marginally.

For the fourth consecutive year, according to CEFIC, West European domestic chemical demand in 1989 was the main driving force for the industry's sales. Exports rose 5.2%, but that was down from 7.6% in 1988, as unfavorable currency effects—primarily the weak U.S. dollar and Japanese yen—cut into export business. The weakening in exports is expected to continue, with growth in volume down to 3.5% this year, the federation predicts. As counterpoint, imports, which rose 9.7% in 1988, were up 9.9% last year; however, that growth is expected to taper off slightly to an expected 6% this year.

Metz: decade of communications

Overall, in 1989, chemicals continued as a positive contributor to the balance of trade in Western Europe. Exports less imports in 1989 were $25.8 billion, according to CEFIC statistics, roughly the same in local currency values as in 1988. The comparable number for the U.S. was $16.2 billion. Japan was a net importer of chemicals, with its imports less exports totaling $1.13 billion, an increase of 38% from 1988.

Statistics can make a simple, straightforward picture. But a complicated task for CEFIC at this annual meeting was to realign its industry executives who serve as president and vice president of the association. The hasty but dignified reshuffle was forced by the illness of the president-elect, Jean-Marc Bruel, of Rhône-Poulenc, who was scheduled to take over as president at the meeting.

As a result, Günter Metz, retiring president of Hoechst, was reelected president until January 1991, when he will be succeeded by new vice president Daniel Janssen, of Solvay. Janssen, who had been scheduled to succeed Bruel, will serve until June 1992, when he, in turn, will be succeeded by Jacques Puéchal, of Atochem.

The management reshuffle came, additionally, as CEFIC has embarked on a strategic planning mission, to chart "CEFIC 2000," developing for the federation "an international strategy that will take us beyond the confines of Europe and beyond the horizons of the immediate future," as Metz put it.

As the industry enters what he sees as "the decade of communications," it must ensure that CEFIC, its member national associations, and its affiliate member companies "speak to the outside world with a single voice. CEFIC must view its activities now on a truly international scale," Metz said, an indication of how much it has developed since its founding 18 years ago.

Besides the national chemical industry associations, it includes 43 individual companies as members of its Assembly of Corporate Associate Members, and more than 70 sector groups, special interest groups within the chemical industry. CEFIC itself is also a member of the International Council of Chemical Associations, whose other members also include the Chemical Manufacturers Association in the U.S., and the Japanese and Canadian associations.

"I expect that at the next general assembly in 1991, we shall present a new management board and an executive management committee for the entire organization," he predicted. "The new management board will combine both national federations and chemical companies in one body."

CEFIC, whatever its new structure, will be faced with continuing challenges in the environmental field, national and international regulations on such topics as biotechnology, and—with a dramatic flourish last year—the opening of the borders to East bloc nations in Central and Eastern Europe.

According to Metz, "The Western world should be unanimous in supporting the political and economic reform" in the East bloc. "There is a chance to extend the European Community integration process to Central and Eastern Europe. The unification of the two German states will bring the German Democratic Republic into the EC." And the chemical industry "could be a major partner in this process."

Both the Polish and Hungarian national chemical industry associations have expressed a wish to join CEFIC as soon as possible, he said. "For the time being, we have been able to offer them a relationship that involves cooperation and assistance on a variety of matters."

In a subsequent question as to why CEFIC did not accept these two associations immediately, the federation's director general, Hugo Lever, said that "nothing in principle stops us from accepting them. But they have not yet organized themselves so they can join. We need to help them do that, to organize themselves to represent the chemical industry. Within five years, they will be members, is my guess."

CEFIC executives are all keen to work with the chemical industries of the East bloc. However, they are much less so about dealing with the industry of the Mideast, specifically the countries in the Gulf Cooperation Council.

GCC is seeking free-trade agreements with the European Community, particularly for petrochemicals. The Western European petrochemicals industry, under the aegis of the Association of Petrochemicals Producers in Europe (APPE), has lobbied against the notion, and for a while seemed to be winning the arguments. Changes in the top echelons within the EC, however, and some less than subtle political pressures have caused the EC to reconsider.

Said Metz, "I consider the decision by the community to begin negotiations on a future free-trade agreement between the EC and six-nation Gulf Cooperation Council very unfortunate. CEFIC has worked closely with APPE to oppose the idea of such an agreement, ever since it was first proposed in 1984. However, political pressures for such a pact have been applied, and by late last year, both the European Commission and the Council of Ministers altered their stances and decided to open negotiations. I believe that the interests of the Western European petrochemical industry have in fact been sacrificed as a result of this political pressure."

CEFIC has now had two discussion meetings with companies from the GCC countries, one in Granada, Spain, earlier this year, and one in Brussels last week. According to Michael Cockburn, CEFIC's energy expert and representative for APPE, "Our strategy first is to gain time. There is a lot of political pressure, but we do have constructive dialogue developing between us and the companies there in GCC. Although we have been adamant in our resistance to this, it is now on the table, so we are trying, as industrialists, to have discussion with the principal operators in the gulf. We're exchanging views on what

Chemical industry growth is slowing but still healthy

% change from previous year	1988	1989	1990
Gross domestic product	3.3%	3.5%	3.0%
All manufacturing	5.1	4.3	3.0
Chemical industry output	6.7	3.4	2.5
Chemical exports[a]	7.6	5.2	3.5
Chemical imports[a]	9.7	9.9	6.0
Chemical investments	13.0	10.6	8.5
Chemical industry employees	0.7	1.1	0.5

a Includes trade among Western European countries. **Source:** European Chemical Industry Federation (CEFIC)

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the industry can do or expect, in areas, for example, such as plastics waste management."

For CEFIC, the annual meetings have also become a welcome opportunity to focus on contributions the industry is making to the environment, rather than just to bemoan problems with environmentalists, hyperactive legislators, and others. This year, the meeting marked the emergence of the humble 55-gal steel drum as an environmental superstar in the second biennial CEFIC environmental award. The first award was given in 1988 for newly devised technology for restoring historical art treasures. This year's award was far more mundane, but far more practical and of much more significance to the everyday world of the chemical industry.

The award, amounting to approximately $30,000, went to Mauser-Werke GmbH, of Brühl, West Germany, for its "optimally drainable steel drum." Mauser (no connection to the Mauser of armaments fame) introduced the new drum design, which can work on either steel drum or plastic drum or can, in 1989. It features a newly designed top end that helps drain and empty contents out of the drum.

According to Märten Burgdorf, director of Mauser, in traditional designs some 800 to 1200 g of material usually remain in a drum and can't be removed. This then must be dealt with by a drum reconditioner, usually in hazardous waste disposal. The units tend to become a bit interchangeable, but his point is clear: "The target of our research work was to empty the drum, 1 L more. Instead of 1000 g, we wanted to empty it to zero or at least down to 50 g." By Burgdorf's estimates, if the industry could save 1 L for each of the 35 million drums manufactured and the 16 million reconditioned yearly in Western Europe, it would be "a tremendous savings in hazardous wastes."

"Worldwide," he adds, "there are 120 million new drums and 110 million reconditioned drums filled every year. With the new design, 230,000 [cubic meters] of hazardous waste are avoided—an amount of 100 meters length, 100 meters width, and 23 meters height." □

Tight supply of acrylic esters to continue

The supply of acrylic esters is expected to continue to be tight, concludes a recent report by Eldib Engineering & Research Inc., a chemical market research firm located in Berkeley Heights, N.J. Acrylic esters include *n*-butyl acrylate, ethyl acrylate, 2-ethylhexyl acrylate, and methyl acrylate. U.S. supply has been tight for a couple of years, says Paul Gierer of Eldib, because production has not met the growing demands of major end-use markets. Tight supply of acrylic acid feedstock is also a contributing factor.

With the current very high capacity use for acrylic esters, Gierer says, the situation is not expected to improve until capacity additions by the major producers are brought on line in the next year or two. According to SRI International, as of January 1990, producers of acrylic esters are BASF, Union Carbide, Hoechst Celanese, and Rohm & Haas, with a total industry capacity of 1.46 billion lb. Significant expansions noted in the report that are slated to be completed in the next couple of years are 150 million lb per year by Hoechst Celanese at Clear Lake, Tex.; 200 million by Rohm & Haas at Deer Park, Tex.; and at least a 70% increase by Union Carbide at its Taft, La., site.

Although U.S. capacity will reach nearly 2 billion lb per year with the announced expansions, a large percentage of U.S. output goes into captive use or is exported. And, with production levels now below demand, Eldib reports that some suppliers are imposing restrictions on order size or are unable to accept new customers. The current tight supply situation, which will exist at least until the expansions are completed, is making the U.S. market attractive to foreign suppliers.

Ann Thayer

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Administration Documents 20 Years Of Environmental Improvement

Economy grew 70% and population 22%, but most major air quality pollutants, including carbon monoxide, lead, and SO_2 were slashed

David J. Hanson, C&EN Washington

The President's Council on Environmental Quality has released its 20th annual report on the condition of the nation's air, land, and water. Departing from the more statistical treatments of this information in the past, this report tries to look at overall gains during that period. The general conclusion is that the problems addressed in the past 20 years have been substantially dealt with, but new pollution issues are proving more difficult to resolve.

"This report is a 20-year perspective on the U.S. environment," says CEQ chairman Michael R. Deland. "The results are heartening. The American public can take comfort and pride in the progress it has made." The CEQ report itself is a sign of some progress. As the first environmental office set up under the 1970 National Environmental Policy Act, CEQ had lost most of its staff and functions during the Reagan Administration. Deland has helped revitalize the council, doubling its staff to about 20 and planning on doubling it again in the next year.

The CEQ report makes much of the progress made in many areas of environmental cleanup. It points out that in the area of air pollution, most major air quality pollutants have been significantly reduced. Annual emissions of lead are down 96% from 20 years ago, particulate emissions 61%, and sulfur dioxide emissions 28% since 1970. For carbon monoxide, total emissions have fallen 38%, but despite this progress many urban areas in the U.S. still exceed national health standards. Only emissions of nitrogen oxides increased, rising 8%, but this is not considered high enough to be a serious health problem.

Deland makes a strong point about these reductions because they show that "the U.S. has clearly severed the linkage between economic growth and pollution growth, a linkage that seemed obvious and unbreakable to many people in 1970." During this period of air pollution reduction, CEQ reports that the economy has grown 70% and the population 22%.

The report makes it clear that not all of the nation's pollution problems are solved. In particular it points out the problem of disappearing wetlands and the general problem of declines in the quality of coastal waters and estuaries in the past two decades. Some of this is attributed to population growth along coastlines, which leads to more runoff and the filling in of wetlands. Increasing agriculture is also seen as a major contributor to wetlands loss.

Deland: the results are heartening

Considering the environmental progress in general, the report observes that the U.S. has been successful in improving environmental quality when the existence of a problem has been widely recognized and the sources of the problem well defined. This fits with the improved air pollution data. But in cases where general recognition of a problem emerged slowly over time, as in the case of acid rain or chlorofluorocarbon contamination, or in cases where the sources of a problem are diverse, environmental progress has been slow and painful.

A major chapter in the report deals with the broad issue of pollution prevention. In addition to discussing the role industry plays here, the report includes energy efficiency, agricultural practices, and consumer lifestyles as part of this issue. Economics is given credit for starting the shift from so-called end-of-pipe controls to finding ways to reduce the amount of waste generated to begin with. The CEQ report cited 3M as a pioneer in the field for beginning its "Pollution Prevention Pays" program in 1975. Since then, incentives for companies to reduce levels of waste have increased tremendously, making it financially sound to explore pollution prevention. Passage of new regulations, such as the Section 313 requirements under the 1986 Superfund reauthorization that force companies to report annual releases of toxic chemicals, are cited as adding pressure to companies to cut pollution.

CEQ mentions a few challenges

ahead for pollution prevention. One of the most critical is that many smaller businesses do not have access to the technical information on profitable pollution prevention strategies that are developed by the larger corporations. Because of the highly competitive nature of business, CEQ recognizes that sharing information is not straightforward. CEQ hopes that programs devised by state agencies and the Environmental Protection Agency will facilitate this technology transfer without jeopardizing proprietary data. Strong corporate leadership is also needed to overcome industry's inherent resistance to change.

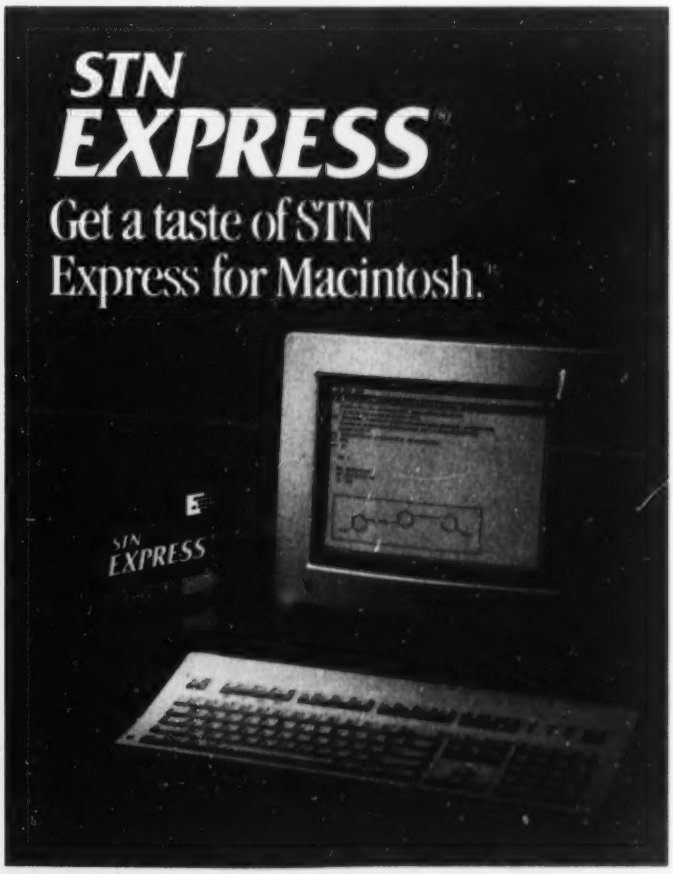
Pollution abatement costs chemical industry billions yearly

	Capital expenditures			Operating costs			
$ Millions	Air	Water	Solid waste	Air	Water	Solid waste	Total
1973	$164.4	$214.6	$ 16.8	$174.1	$ 247.6	$ 80.2	$ 897.7
1974	250.6	264.4	24.1	203.8	335.6	104.0	1182.5
1975	359.5	387.7	35.0	249.9	430.9	126.7	1589.7
1976	319.8	577.4	44.7	295.6	514.7	173.2	1925.4
1977	339.9	593.1	49.6	335.5	685.2	217.6	2220.9
1978	376.3	385.9	65.1	398.8	794.1	280.1	2300.3
1979	314.6	360.7	95.6	485.3	895.2	287.0	2438.4
1980	325.9	350.0	104.8	539.9	942.9	368.8	2632.3
1981	335.0	322.2	95.6	571.7	1069.1	406.9	2800.5
1982	272.8	256.5	98.3	556.1	1112.3	438.2	2734.2
1983	159.0	187.4	49.0	624.9	1106.0	467.4	2593.7
1984	142.9	212.4	32.7	622.0	1206.3	517.1	2733.4
1985	193.7	271.5	272.5	672.9	1267.7	599.4	3223.7
1986	197.8	325.5	101.0	646.5	1301.8	705.9	3278.5

Source: Council on Environmental Quality

International issues occupy a major portion of the report and it goes into some detail on the various programs in which the U.S. is involved. Although it reviews the major international issues, such as acid rain and global warming, it makes no judgments about the U.S. position on these issues or how it might be at odds with other nations' views. Other international problems CEQ discusses include transboundary movement of hazardous waste, biodiversity of species and habitats, and threats to the world's oceans. The report includes extensive lists of U.S. meetings on these and other issues and bilateral and multilateral environmental agreements into which the U.S. has entered.

In keeping with the very different nature of this CEQ report, there is a chapter devoted to the impact science and technology has had on environmental policies. This is the first



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time CEQ had given so much attention to technology, even though it has been the technology developments of the past 20 years that have fueled many of the environmental issues of today.

The development of advanced gas chromatography-mass spectrometry systems is highlighted as the leading reason for progress in many areas. By moving detection limits from the parts-per-thousand range to the parts-per-trillion range and lower, many pollutants that once went undetected are now routinely measured. And over the years, a library of "fingerprints" for chemical identification can use computers to match contaminating chemicals with the producers. Other technological advancements cited include atomic absorption spectroscopy, and inductively coupled plasma spectrometers.

Advanced instrumentation now routinely measures pollutants that once went undetected

Research and development isn't ignored either. The trend CEQ emphasizes is toward partnerships among private, academic, and government sectors. Twenty years ago there was little interplay among these institutions to deal with environmental problems. Now many organizations are supporting research to solve these issues. The Superfund Innovative Technology Evaluation program is mentioned as an example of how the government is helping the private sector develop better technology for waste site cleanups. However, though other programs are mentioned, CEQ doesn't go into the amount of effort industry has had to invest over the past 20 years to meet federal pollution requirements.

As a retrospective analysis, the report dwells mostly on the past and does not spend much time on the issues that have only recently become serious concerns. The current policies on issues such as global warming and chlorofluorocarbon depletion of stratospheric ozone are pretty much left to future volumes. There are extensive chapters included on improvements in enforcement of environmental regulations and on the history of contamination problems in the Great Lakes.

Tom Super, who was the overall manager of the report, says CEQ tried to stay as apolitical in preparing this report as it could, but still the overall view is one of substantial progress. "In a pluralistic society, incremental progress toward long-term goals is what we should strive for. And this incremental progress will be fraught with political strife and energy. We took a look at the cumulation of these incremental changes over the past 20 years and found all areas positive," Super explains. □

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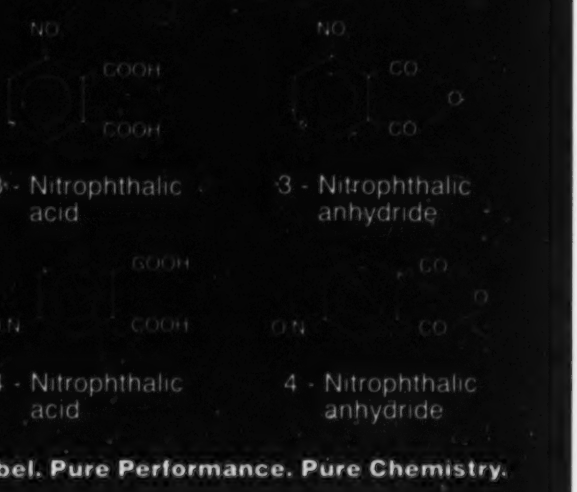

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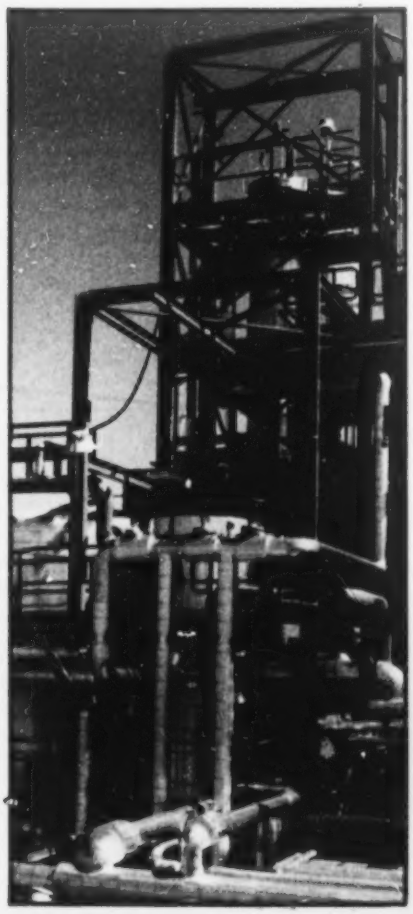
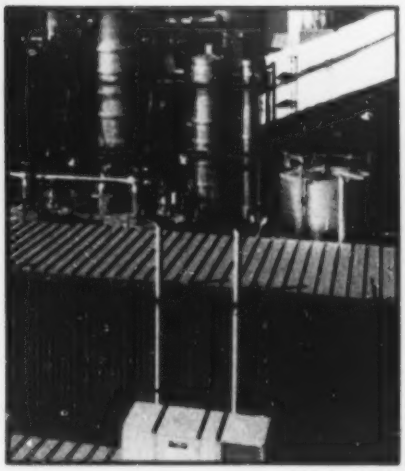


at a glance

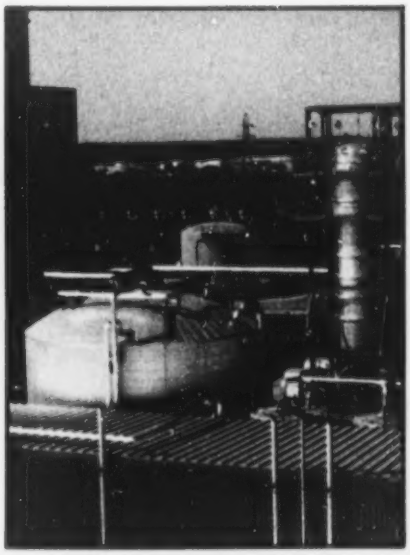
Section One: Production

Output of chemicals continued to expand in the U.S. last year, but the increase was slower than in any of the three previous years. And for the big-volume commodity chemicals that are the core of the industry, the record was spotty. Ethylene production, for example, was down 6% from the year before and styrene nearly 10%. Plastics, which in recent years had set the growth pace for the industry, also were hit by a poor year, with polyethylene particularly lackluster. For synthetic fibers, the year was flat. **Page 36**



Section Two: Finances

The surge in profits enjoyed by U.S. chemical firms since 1986 stalled in 1989. Profitability fell sharply, in fact, for several of the biggest producers of basic chemicals. Even so, for the industry as a whole, net income remained high in comparison with any year prior to 1988. The industry also continued to spend more heavily for new plants, although 1989's increase was far less than 1988's. R&D budgets also rose more moderately. **Page 45**



Section Three: Employment

The number of people working in the chemical industry increased somewhat less than 3% last year, reaching a level close to its high of about a decade ago. Growth has been strongest in such areas as drugs and toiletries. Productivity improved, but not nearly so much as in recent years. **Page 60**

for the chemical industry

Last year was a good one for the chemical industry, but as the data tabulated and graphed on the following pages of C&EN's annual Facts & Figures issue demonstrate, it was hardly one to cheer about.

The U.S. increased its output of chemical products. The gain of 3% was well below that of the previous three years, however, as demand in many of the major markets for chemicals weakened appreciably after being relatively strong when the year began. As a result, most of the growth in chemical production was chalked up early on; at year's end output was running about at the same level as when it began.

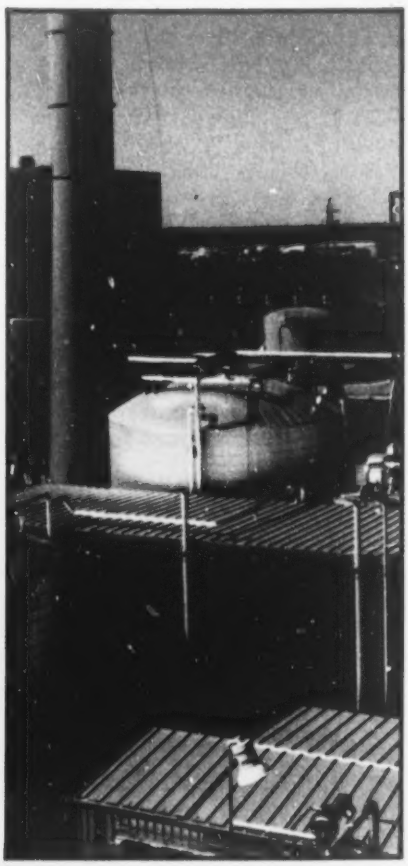
At the same time, production capacity had been built up rapidly in the past year or so. As a result, although prices for chemicals were up on average for the year as a whole, with competitive pressures building, they weakened considerably for many products as the year wore on. One glaring consequence was a decided drop in chemical companies' earnings during 1989's second half.

Section Four: Markets

Although continued growth in spending on the part of U.S. consumers kept demand for chemical products high in 1989, some major markets weakened. Home building was down for the third year as housing starts fell to the fewest since 1982. Motor vehicle assemblies also slipped. **Page 64**

Section Five: Foreign Trade

With U.S. companies boosting their exports a healthy 13% last year to capture a bigger share of the growing world market for chemicals, the trade surplus in chemicals widened further to almost $16 billion. Only West Germany surpassed the U.S. as a chemical exporter. **Page 66**



Section Six: Foreign Chemical Industries

Business continued favorable for chemical industries throughout the industrialized world in 1989. In Western Europe, profits remained high even though output dipped for many chemicals. In Japan, earnings were strong, as well. But in Canada, lower demand and prices cut into income. And in East Europe, output deteriorated. **Page 70**

Growth slackens appreciably as 1980s end

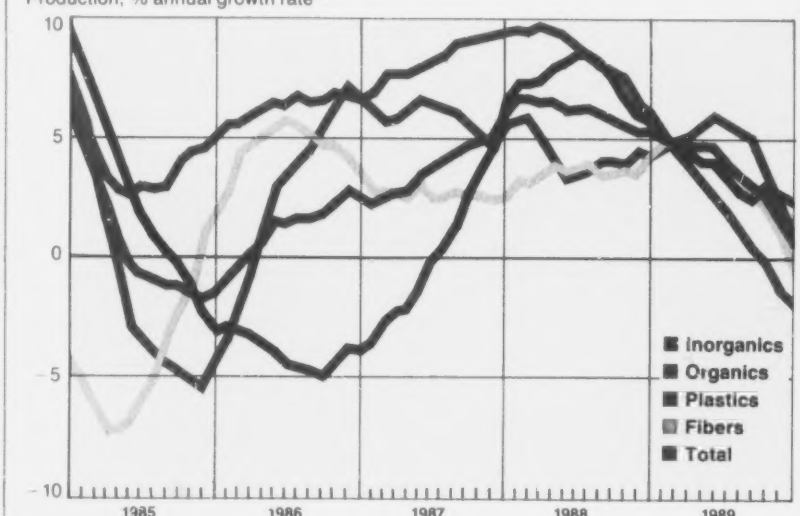
Production by the U.S. chemical industry was showing signs of softness as it ended the decade of the 1980s. The strong and steady growth that characterized most of the second half of the 1980s was slackening appreciably by decade's end. Although overall output for chemicals posted a 3% gain in 1989 over 1988 levels, the rise was considerably less than its average annual increase of 5% in the three previous years. The slowdown was more dramatic for the largest-volume chemicals, C&EN's Top 50, which posted only a 0.2% gain in 1989 production, compared with 7% growth in 1988. By the end of 1989, production growth rates were much lower for all major sectors of the chemical industry.

Most of the big drops in production came in the organic chemicals sector. Output of the largest-volume organic chemicals as a group declined more than 3% in 1989, led by a 6% drop for ethylene, 5% for propylene, 12% for methanol, 8% for toluene, and a whopping 19% for terephthalic acid. By contrast, ethylene dichloride, carbon dioxide, and vinyl chloride all posted output gains in 1989, rising 5%, 7%, and 6%, respectively.

Production within the inorganics segment of the largest-volume chemicals rose overall 2%, thanks to solid, if unspectacular growth in the biggest-volume products in this class, such as sulfuric acid, nitrogen, and lime, each up 3%; oxygen, up 1%; and sodium hydroxide, up 5%.

Synthetic fibers showed no net change in 1989. Fertilizer consumption was also unchanged in the year that ended last June, compared with 2% growth in each group in 1988. Synthetic rubber output grew only 1% last year, down from a 7% gain the year before. Of all market sectors, only pesticides showed major growth in output in 1989, increasing 12% over the previous year.

Growth slowed markedly for all chemical sectors in 1989



a Average running annual growth rates in production of major plastics, inorganic and organic chemicals, and all chemicals, and in shipments of man-made fibers. **Sources:** International Trade Commission, Bureau of the Census, Society of the Plastics Industry, Textile Economics Bureau

Chemical production overall leveled off

a Seasonally adjusted. **Source:** Federal Reserve Board

TOP 50 CHEMICALS: Overall production has changed little since 1979

Rank			Billions of lb		Common units[b]		Average annual growth			
1989	1988[a]		1989	1988	1989	1988	1988–89	1987–88	1984–89	1979–89
1	1	Sulfuric acid	86.80	84.28	43,399 tt	42,141 tt	3.0%	7.3%	0.8%	0%
2	2	Nitrogen	53.77	52.32	742 bcf	722 bcf	2.8	10.4	2.3	5.7
3	3	Oxygen	37.75	37.42	456 bcf	452 bcf	0.9	15.9	3.4	0
4	4	Ethylene	34.95	37.20	34,953 mp	37,203 mp	−6.0	6.3	2.2	1.6
5	5	Ammonia	33.76	33.64	16,878 tt	16,821 tt	0.3	4.1	0.2	−1.0
6	6	Lime[c]	32.99	32.02	16,495 tt	16,011 tt	3.0	5.5	0.6	−2.4
7	7	Phosphoric acid	23.12	23.35	11,559 tt	11,677 tt	−1.0	11.5	0.3	1.1
8	8	Chlorine	22.32	22.51	11,161 tt	11,257 tt	−0.9	2.5	0.8	−0.9
9	10	Sodium hydroxide	22.15	21.05	11,075 tt	10,527 tt	5.2	8.6	0.3	−1.4
10	9	Propylene	20.23	21.22	20,229 mp	21,224 mp	−4.7	14.6	5.4	3.6
11	11	Sodium carbonate[d]	19.79	19.26	9,896 tt	9,632 tt	2.7	8.3	3.1	1.8
12	12	Nitric acid	15.98	15.98	7,991 tt	7,991 tt	0	12.5	0.7	−1.1
13	13	Urea[e]	15.47	15.83	7,733 tt	7,914 tt	−2.3	6.4	0.8	1.0
14	14	Ammonium nitrate[f]	15.11	15.01	7,557 tt	7,504 tt	0.7	17.0	1.1	−0.9
15	15	Ethylene dichloride	13.68	13.03	13,675 mp	13,028 mp	5.0	−5.6	5.0	1.5
16	16	Benzene	11.67	11.73	1,585 mg	1,593 mg	−0.5	0.5	3.8	−0.5
17	18	Carbon dioxide[g]	10.83	10.12	5,413 tt	5,058 tt	7.0	2.6	3.5	6.1
18	20	Vinyl chloride	9.62	9.06	9,618 mp	9,058 mp	6.2	10.1	9.6	4.2
19	19	Ethylbenzene	9.22	9.93	9,223 mp	9,929 mp	−7.1	5.5	4.1	0.9
20	17	Terephthalic acid[h]	8.31	10.23	8,309 mp	10,234 mp	−18.8	26.2	7.0	3.0
21	21	Styrene	8.13	8.98	8,129 mp	8,984 mp	−9.5	11.1	1.1	0.8
22	22	Methanol	7.14	8.14	7,139 mp	8,142 mp	−12.3	11.7	−2.7	−0.3
23	24	Formaldehyde[i]	6.37	6.28	6,370 mp	6,280 mp	1.4	3.3	1.8	0.6
24	23	Toluene[j]	5.84	6.35	805 mg	875 mg	−8.0	−5.7	2.0	−2.2
25	29	Xylene	5.80	5.48	805 mg	761 mg	5.8	−4.3	−1.2	−1.9
26	28	Ethylene glycol	5.50	5.52	5,499 mp	5,517 mp	−0.3	22.2	2.7	1.5
27	27	*p*-Xylene	5.49	5.60	5,494 mp	5,601 mp	−1.9	8.7	5.2	1.7
28	25	Ethylene oxide	5.32	5.95	5,322 mp	5,953 mp	−10.6	5.9	−1.4	−0.8
29	30	Hydrochloric acid	5.26	5.28	2,628 tt	2,640 tt	−0.5	−11.9	−0.5	−1.6
30	26	Methyl *tert*-butyl ether[k]	4.98	5.68	4,976 mp	5,680 mp	−12.4	68.4	29.3	na
31	31	Ammonium sulfate	4.71	4.67	2,354 tt	2,333 tt	0.9	6.9	2.6	0
32	32	Cumene	4.54	4.46	4,535 mp	4,455 mp	1.8	7.3	3.9	1.5
33	33	Phenol[l]	3.89	3.56	3,893 mp	3,562 mp	9.3	9.9	6.1	2.7
34	36	Acetic acid	3.83	3.16	3,826 mp	3,159 mp	21.1	−2.1	7.9	1.6
35	34	Potash[m]	3.35	3.35	1,521 tmt	1,521 tmt	0	20.5	−0.6	−3.7
36	37	Propylene oxide	3.20	3.11	3,200 mp	3,110 mp	2.9	19.2	12.5	3.6
37	35	Butadiene[n]	3.09	3.17	3,094 mp	3,169 mp	−2.4	5.6	4.8	−1.5
38	38	Carbon black	2.91	2.92	2,913 mp	2,916 mp	−0.1	7.0	0.1	−1.3
39	39	Acrylonitrile	2.61	2.61	2,608 mp	2,609 mp	0	2.3	3.3	2.6
40	42	Acetone	2.50	2.30	2,497 mp	2,303 mp	8.4	10.6	6.0	−0.6
41	40	Vinyl acetate	2.47	2.56	2,470 mp	2,561 mp	−3.6	2.2	4.1	2.2
42	42	Cyclohexane	2.39	2.30	2,389 mp	2,297 mp	4.0	2.1	3.7	−0.1
43	41	Aluminum sulfate	2.35	2.46	1,173 tt	1,232 tt	−4.8	0.7	0.8	−1.1
44	44	Titanium dioxide	2.22	2.04	1,110 tt	1,022 tt	8.6	7.4	5.9	4.1
45	48	Calcium chloride[o]	1.92	1.46	960 tt	729 tt	31.7	−5.7	−1.8	−0.2
46	46	Sodium silicate	1.75	1.62	877 tt	812 tt	8.0	−14.7	5.1	0.8
47	47	Adipic acid	1.64	1.60	1,640 mp	1,600 mp	2.5	1.8	3.4	−0.6
48	45	Sodium sulfate[p]	1.60	1.63	800 tt	817 tt	−2.1	1.5	−1.7	−3.3
49	49	Isopropyl alcohol	1.43	1.39	1,432 mp	1,389 mp	3.1	5.8	0.5	−2.8
50	50	Caprolactam	1.31	1.26	1,312 mp	1,261 mp	4.0	8.6	5.0	3.3
TOTAL ORGANICS			210.61	217.69			−3.3%	7.8%	3.6%	1.4%
TOTAL INORGANICS			400.44	392.41			2.0%	7.0%	1.3%	0.2%
GRAND TOTAL			611.04	610.11			0.2%	7.3%	2.0%	0.6%

a Revised. b tt = thousands of tons, bcf = billions of cubic feet, mp = millions of pounds, mg = millions of gallons, tmt = thousands of metric tons. c Except refractory dolomite. d Natural and synthetic. e 100% basis. f Original solution. g Liquid and solid only. h Includes both acid and ester without double counting. i 37% by weight. j All grades. k Production data for earlier years unavailable. l Synthetic only. m K_2O basis. n Rubber grade. o Solid and liquid. p High and low purity. na = not available.

PRODUCTION: 1989 was a strong year for basic chemicals, a poor one for synthetics

Industrial production indexes, 1987 = 100	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	Annual change 1988–89	Annual change 1979–89
Total index	108.1	105.4	100.0	95.3	94.4	92.8	84.9	81.9	85.7	84.1	85.7	3%	2%
Manufacturing, total	108.9	105.8	100.0	94.3	91.6	89.3	80.9	76.6	80.3	78.8	80.9	3	3
Nondurable manufacturing	106.4	103.6	100.0	94.9	91.5	90.8	87.0	82.5	84.5	83.1	84.6	3	2
Chemicals and products	108.5	105.4	100.0	94.6	91.4	91.4	87.5	81.8	89.2	87.8	91.3	3	2
Chemicals and synthetic materials	106.5	102.5	100.0	93.9	92.2	92.8	88.6	79.4	91.2	86.3	96.6	4	1
Basic chemicals	106.6	98.3	100.0	95.1	96.1	96.9	92.1	86.5	96.9	96.5	101.8	8	0
Alkalies and chlorine	103.2	96.0	100.0	92.1	93.6	95.3	87.9	82.1	94.6	101.5	110.7	8	−1
Industrial gases	108.0	104.1	100.0	98.8	92.8	97.5	85.9	80.1	91.2	91.5	93.3	4	1
Inorganic pigments	111.0	102.6	100.0	96.2	95.1	89.0	87.3	79.1	90.7	90.6	93.3	8	2
Inorganic chemicals, nec	105.7	96.4	100.0	94.7	97.2	98.0	94.3	89.2	98.7	96.8	102.4	10	0
Industrial organic chemicals	109.2	103.1	100.0	95.1	94.1	93.4	89.9	81.0	97.0	92.8	101.8	6	1
Synthetic materials	103.1	104.4	100.0	91.6	86.9	88.9	84.3	71.8	79.5	71.2	85.8	−1	2
Plastics materials	106.7	106.8	100.0	88.2	84.1	81.1	74.4	64.4	68.3	64.2	70.4	0	4
Synthetic rubber	92.4	105.0	100.0	109.3	114.4	132.8	124.1	110.5	114.5	110.8	130.0	−12	−3
Man-made fibers	98.7	99.5	100.0	93.7	86.6	93.3	92.3	76.4	91.7	74.9	104.6	−1	−1
Chemical products	110.1	107.5	100.0	95.9	90.2	89.0	86.6	83.0	85.4	87.6	85.8	2	3
Drugs and medicines	108.1	107.2	100.0	96.7	88.5	86.9	86.1	82.7	80.9	80.2	77.1	1	3
Soaps and toiletries	111.1	107.9	100.0	96.7	91.3	90.6	91.4	89.2	97.7	103.5	97.9	3	1
Paints	104.8	103.9	100.0	97.5	95.7	91.8	84.6	78.8	84.1	87.0	92.2	1	1
Agricultural chemicals	108.2	107.2	100.0	88.5	96.1	102.0	87.5	88.8	102.3	97.2	93.7	1	1
Petroleum products	106.1	103.4	100.0	98.9	92.6	92.8	89.6	89.3	94.1	99.0	107.2	3	0
Rubber and plastics products	108.9	105.9	100.0	90.8	85.8	83.8	74.3	65.9	66.6	61.7	67.9	3	5

nec = not elsewhere classified. **Source:** Federal Reserve Board

MINERALS: Production increased for most chemical minerals last year

Thousands of tons	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	Annual change 1988–89	Annual change 1979–89
Bromine, sold or used[a]	190[b]	180	168	155	160	193	185	200	189	189	249	6%	−3%
Calcium chloride, production[c,d]	962[b]	731	658	780	940	1,036	912	853	917	811	981	32	3
Lime, sold or used[e]	17,079[b]	16,658	15,733	14,474	15,690	15,922	14,867	14,075	18,890	19,037	20,983	3	−2
Lithium, consumption[d,f]	3.2[b]	3.0	2.7	2.6	2.5	3.2	2.2	2.0	3.2	3.0	3.2	7	0
Phosphate rock													
Marketable production	53,900	50,000	45,145	44,445	56,035	54,230	46,928	41,241	59,110	59,982	56,891	8	−1
Exports	9,036	8,920	9,319	8,651	10,071	12,707	13,239	10,849	11,458	15,737	15,827	1	−4
Potash (K_2O equivalent)[g]													
Production	1,700[b]	1,677	1,391	1,325	1,429	1,724	1,575	1,967	2,377	2,468	2,453	1	−4
Imports[i]	4,740[b]	4,648	4,490	4,643	5,063	5,323	4,894	4,253	5,287	5,481	5,693	2	−2
Apparent consumption	6,020[b]	5,803	5,609	5,338	5,893	6,638	6,231	5,647	6,849	6,999	7,626	4	−2
Salt, production[h]	38,466[d]	39,170	36,943	37,282	39,217	39,181	32,973	37,665	38,899	40,396	45,820	−2	nc
Evaporated[i]	6,851[d]	7,203	6,896	6,316	6,162	6,334	5,276	5,273	6,206	6,358	6,248	−5	nc
Rock[i]	13,945[d]	12,750	12,230	13,333	13,990	13,653	11,870	12,806	11,866	11,806	14,891	9	nc
Salt in brine[i]	17,671[d]	19,218	17,817	17,633	19,065	19,195	15,827	19,586	20,826	22,231	24,681	−8	nc
Sodium carbonate, production[j]	9,775[b]	9,632	8,891	8,438	8,511	8,511	8,467	7,819	8,281	8,275	8,253	1	2
Sulfur, production[k]	12,778	11,845	11,616	12,221	12,797	11,742	10,240	10,788	13,388	13,080	13,339	8	0
Apparent consumption[l]	13,983	14,012	12,481	11,669	13,192	13,976	12,112	11,088	14,093	15,056	15,145	0	−1
Frasch, production	4,286	3,499	3,530	4,457	5,524	4,622	3,530	4,641	6,997	7,044	7,007	22	−5
Recovered elemental, production	7,176	7,103	6,791	6,411	5,857	5,747	5,462	4,855	4,695	4,490	4,486	1	5
Other, production	1,316	1,243	1,296	1,354	1,416	1,372	1,249	1,293	1,695	1,547	1,845	6	−3

a Elemental bromine sold as such or used in preparation of bromine compounds by primary producers. b Preliminary. c 75% $CaCl_2$ equivalent. d Estimated. e Includes Puerto Rican production. f Lithium content basis. g Includes muriate and sulfate of potash, potassium magnesium sulfate, and parent salts; excludes other chemical compounds containing potassium. h Figures for 1979–80 are total obtained by all recovery methods that was sold or used by domestic producers (slightly different from U.S. production); figures for 1979–81 include Puerto Rican production. i Sold or used as such. j Natural and synthetic for 1979–86, natural only in 1987–89. k Sulfur content basis. l Calculated from shipments plus imports minus exports (sulfur content basis). nc = not comparable. **Source:** Bureau of Mines

ORGANIC CHEMICALS: **Mixed results show 1989 production down more often than up**

Millions of lb unless otherwise noted	Production											Annual change	
	1989[a]	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1988–89	1979–89
Acetic acid, synthetic	3,826	3,159	3,246	2,728	2,897	2,619	2,807	2,748	2,705	2,977	3,265	21%	2%
Acetone	2,497	2,303	1,846	1,910	1,788	1,862	1,859	1,694	2,144	2,076	2,653	8	−1
Acrylonitrile	2,619	2,609	2,452	2,182	2,349	2,219	2,146	2,035	1,997	1,830	2,018	0	3
Aniline	1,025	1,029	829	824	716	786	663	557	634	659	690	0	4
Benzene, mg[b,c]	1,585	1,608	1,575	1,362	1,283	1,318	1,232	1,052	1,308	1,534	1,612	−1	0
Bisphenol A	1,136	1,340	1,000	956	949	762	643	480	555	530	576	−15	7
1,3-Butadiene[d]	3,094	3,169	2,931	2,546	2,340	2,452	2,353	1,915	2,986	2,799	3,583	−2	−1
1-Butanol	1,049	1,194[e]	1,155	881	716	908	833	730	809	790	766	−12	3
Caprolactam	1,312	1,261	1,156	1,109	1,089	1,027	977	793	928	905[e]	945	4	3
Carbon tetrachloride	na	761	672	627	646	713	573	587	726	710	714	na	na
Chloroform	580	524	462	422	275	405	362	299	405	273	356	11	5
Cumene	4,534	4,455	4,105	3,745	2,627	3,754	3,345	2,743	3,309	3,459	3,917	2	1
Cyclohexane	2,388	2,297	2,276	2,070	1,657	1,994	1,656	1,275	1,820	1,964	2,425	4	0
Dioctyl phthalate	292	344	343	296	275	301	300	266	304	353	336	−15	−1
Ethanol, synthetic	na	562	574	529	649	1,060	1,077	1,023	1,317	1,451	1,408	na	na
Ethanolamines[e]	632	608	627	543	537	504	468	416	429	376	420	4	4
Ethylbenzene	9,221	9,929	9,346	9,020	7,386	7,562	7,876	6,656	7,813	7,642	8,448	−7	1
Ethyl chloride	na	152	155	164	171	290	282	339	324	396	582	na	na
Ethylene	34,947	37,204	34,951	32,859	29,847	31,383	28,680	24,501	29,418	28,667	29,904	−6	2
Ethylene dichloride	13,673	13,028	12,197	12,940	12,101	10,710	11,506	7,619	9,974	11,108	11,794	5	1
Ethylene glycol	5,498	5,517	5,183	4,771	4,178	4,823	4,425	4,309	4,143	4,386	4,729	0	2
Ethylene oxide	5,321	5,953	4,785	5,430	5,430	5,699	5,534	4,987	4,937	5,220	5,665	−11	−1
2-Ethylhexanol	797	743	662	571	536	541	387	325	389	367	318	7	10
Formaldehyde, 37%[f]	6,369	6,280	5,733	5,549	5,606	5,815	5,465	4,817	5,721	5,555	5,971	1	1
Isobutylene	1,164	1,244	1,035	1,124	na	883	760	741	1,035	1,052	na	−6	na
Isopropyl alcohol	1,432	1,389	1,371	1,301	1,235	1,394	1,209	1,380	1,669	1,836	1,900	3	−3
Maleic anhydride	425	448	382	359	394	359	299	260	293	304	323	−5	3
Methanol, synthetic	7,138	8,142	7,537	7,205	5,003	8,186	7,982	7,555	8,577	7,153	7,367	−12	0
Methyl chloride	414	597	373	605	410	482	409	366	405	362	463	−31	−1
Methyl ethyl ketone	428	482	672	600	537	543	531	468	614	692	716	−11	−5
Methyl methacrylate	1,162	1,100	1,029	943	858	917	844	721	592	564	633	6	6
Methylchloroform	778	724	694	652	869	675	586	595	611	587	656	7	2
Methylene chloride	470	504	516	566	467	607	584	532	891	780	931	−7	−7
Perchloroethylene	475	498	473	414	678	573	547	585	691	765	773	−5	−5
Phenol, synthetic[g]	3,892	3,562	3,351	3,115	2,841	2,889	2,638	2,023	2,578	2,568	2,981	9	3
Phthalic anhydride	1,101	999	1,035	863	820	870	838	684	870	818	1,013	10	1
Propylene[h]	20,225	21,224	19,019	16,522	14,887	15,559	13,959	12,535	13,482	13,676	14,198	−5	4
Propylene glycol	843	840	747	573	500	462	484	400	473	488	610	0	3
Styrene, monomer	8,128	8,984	8,014	7,888	7,622	7,709	6,802	5,942	6,679	6,856	7,484	−10	1
Terephthalic acid, dimethyl ester[i]	8,308	10,234	7,601	6,257	6,490	5,912	5,626	4,843	6,235	6,054	6,159	−19	3
Toluene, mg[b,j]	805	892	967	611	698	728	780	714	852	1,010	1,001	−10	−2
Vinyl acetate	2,469	2,561	1,813	1,710	2,112	2,024	1,963	1,876	1,936	1,922	1,982	−4	2
Vinyl chloride	9,617	9,058	8,402	8,439	9,463	6,084	6,875	4,902	6,874	6,466	6,389	6	4
***o*-Xylene**	842	971	940	788	675	688	781	802	918	995	1,082	−13	−2
***p*-Xylene**	5,493	5,601	5,155	5,035	4,779	4,264	4,114	3,391	4,532	4,238	4,650	−2	2

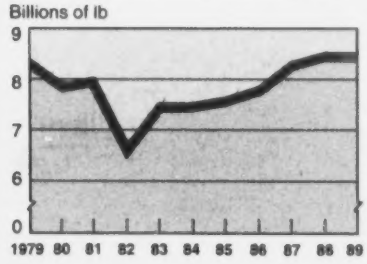
Note: mg = millions of gallons. a Preliminary. b Tar distillers and coke-oven operators not included. c Specification grades. d Rubber grade. e Mono-, di-, and triethanolamines. f By weight. g Does not include data for coke ovens and gas-retort ovens. h All grades. i Includes both acid and dimethyl ester (DMT), without double counting. j High-purity toluene, includes material used in blending motor fuel. na = not available. **Source:** International Trade Commission

INORGANICS: **Most of the best gains last year were for smaller volume products**

Thousands of tons unless otherwise noted	Production											Annual change	
	1989[a]	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1988–89	1979–89
Aluminum sulfate[b]	1,174	1,232	1,227	1,222	1,268	1,129	1,119	1,154	1,294	1,286	1,315	−5%	−1%
Ammonia, 100%[c,d]	16,825	16,821	16,098	14,474	17,319	16,692	14,072	15,801	19,044	19,653	18,634	0	−1
Ammonium nitrate, 100%[e]	7,966	7,504	6,547	6,089	6,776	7,146	6,240	7,091	8,861	9,128	8,293	6	0
Ammonium sulfate, 100%[d,f]	2,354	2,333	2,189	2,080	2,093	2,067	1,956	1,768	2,185	2,136	2,363	1	0
Chlorine gas[g]	11,092	11,257	11,078	10,436	10,402	10,700	9,960	9,176	10,763	11,421	12,291	−1	−1
Hydrochloric acid, 100%[h]	2,681	2,640	2,996	2,413	2,807	2,732	2,468	2,450	2,574	2,888	3,090	2	−1
Hydrogen, bcf, 100%[i,j]	167	177	173	136	121	109	103	88	105	107	106	−6	5
Hydrogen peroxide, 100%[k]	193	177	153	152	144	139	117	108	111	116	114	9	5
Nitric acid, 100%[k]	8,016	7,991	7,225	6,734	7,631	7,726	6,768	7,390	9,093	9,231	8,916	0	−1
Nitrogen gas, bcf, 100%[l,j]	742	722	685	677	665	661	560	483	490	479	427	3	6
Oxygen, bcf, 100%[l,j]	456	452	405	383	393	375	346	349	431	431	456	1	0
Phosphoric acid, 100% P_2O_5	11,566	11,677	10,619	9,578	10,518	11,370	9,767	8,253	9,958	10,848	10,318	−1	1
Phosphorus[m]	365	343	344	364	359	386	366	361	426	432	460	6	−2
Sodium chlorate, 100%	283	267	289	267	259	295	323	291	297	312	269	6	1
Sodium hydroxide, 100%	11,084	10,527	11,553	10,691	10,811	10,914	10,039	9,385	10,621	11,625	12,759	5	−1
Sodium phosphate[n]	580[o]	549	586	617	625	675	669	651	696	727	757	6	−3
Sodium silicate[p]	873	812	952	791	692	685	710	664	771	805	813	8	1
Sodium sulfate, 100%[q]	799	817	799	837	1,203	901	914	864	1,111	1,140	1,121	−2	−3
Sulfuric acid, 100%[r]	43,410	42,141	39,256	35,759	39,651	41,802	36,583	33,233	40,742	44,158	43,204	3	0
Titanium dioxide, 100%[s]	1,109	1,022	968	931	860	835	760	660	761	727	742	9	4
Urea	7,753	7,914	7,433	6,264	6,678	7,433	6,137	6,470	8,062	7,830	7,000	−2	1

Note: bcf = billions of cubic feet. a Preliminary. b Commercial, 17% Al_2O_3; includes municipalities. c Synthetic anhydrous. d Excludes by-product ammonia liquor and ammonium sulfate. e Original solution. f Synthetic and noncoke by-product. g Includes quantities liquefied for use, storage, or shipment. h Includes anhydrous hydrochloric acid production. i High- and low-purity gas. j Liquid and gas; excludes amounts vented and used as fuel, and amounts produced in petroleum refineries for captive use. k Includes unspecified amounts produced but not withdrawn from the system. l Excludes amounts produced and consumed in making synthetic ammonia or ammonia derivatives. m Elemental, white (yellow), and red. n Tripolyphosphate (100% $Na_5P_3O_{10}$). o Includes tetrabasic (pyro) phosphate. p Soluble silicate glass (water glass), solid and liquid (anhydrous); excludes amounts produced and consumed in making meta-, ortho-, and sesquisilicates. q Anhydrous, high and low purity, and Glauber's salt. r Gross (new and fortified). s Composite and pure. **Sources:** Department of Commerce, International Trade Commission

Synthetic noncellulosic fibers output



SYNTHETIC FIBERS: **Only nylon and polyolefins grow, and those modestly**

Millions of lb	Production											Annual change	
	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1988–89	1979–89
NONCELLULOSIC FIBERS													
Acrylic[a]	543	588	592	616	631	671	671	624	691	779	761	−8%	−3%
Nylon[b]	2740	2669	2689	2514	2343	2412	2419	1927	2332	2358	2720	3	0
Olefin[c]	1639	1588	1494	1393	1249	997	906	723	785	748	759	3	8
Polyester	3594	3681	3541	3305	3341	3392	3544	3196	4176	3989	4178	−2	−1
CELLULOSIC FIBERS													
Acetate[d]	580	614	605	619	558	199	229	196	261	316	324	−6	−5
Rayon						421	401	388	509	490	606		
TOTAL	**9056**	**9140**	**8921**	**8447**	**8122**	**8092**	**8168**	**7027**	**8754**	**8680**	**9348**	**0**	**0**

a Includes modacrylic. b Excludes aramid in 1983–87. c Includes olefin yarn and monofilaments and olefin and vinyon staple, tow, and fiberfill. d Includes diacetate and triacetate; excludes production for cigarette filters. **Source:** Fiber Economics Bureau

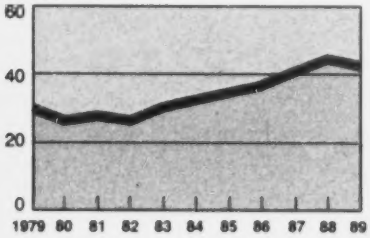
SYNTHETIC RUBBER: Growth of recent years leveled off in 1989

Thousands of metric tons	Production											Annual change	
	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1988–89	1979–89
Ethylene-propylene	260	263	254	230	215	215	175	123	178	144	175	−1%	4%
Nitrile	69	76	69	59	53	67	55	45	66	63	75	−9	−1
Polybutadiene	411	407	371	336	330	359	333	288	342	311	397	1	0
Styrene-butadiene rubber	874	909	850	792	735	958	904	876	1032	1074	1378	−4	−5
Other[a]	688	679	638	596	505	556	468	498	404	423	509	1	3
TOTAL	**2302**	**2335**	**2182**	**2013**	**1838**	**2155**	**1935**	**1830**	**2022**	**2015**	**2534**	**1%**	**−1%**

a Includes butyl, polychloroprene, polyisoprene, silicone, and other synthetic elastomers. Some values are estimated. **Source:** Rubber Manufacturers Association

Plastics production

Billions of lb

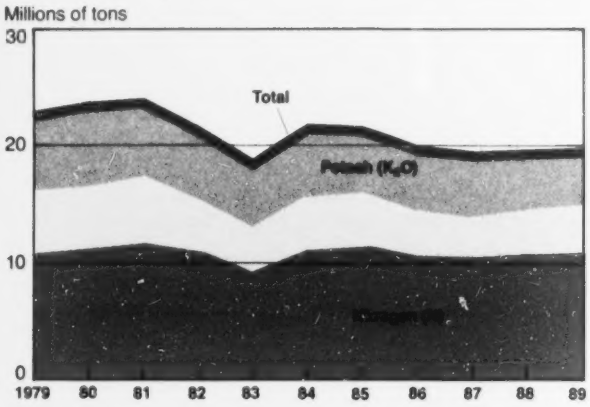


PLASTICS: Production of major resins generally declined last year

Millions of lb[a]	Production											Annual change	
	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1988–89	1979–89
THERMOSETTING RESINS													
Epoxy[b]	510	486	433	398	385	406	334	286	336	315	361	5%	4%
Melamine	222	207	212	173	192	210	180	158	179	167	200	7	1
Phenolic[c]	2,879[d]	3,066[d]	2,869[d]	2,735[d]	2,621[d]	2,502[d]	2,477[d]	2,006[d]	2,333[d]	1,499	1,781	−6	nc
Polyester[e]	1,319	1,404	1,367	1,271	1,223	1,232	1,084	865	997	947	1,147	−6	4
Urea	1,477	1,425	1,382	1,271	1,210	1,199	1,172	998	1,165	1,165	1,367	4	1
TOTAL	**6,407**	**6,588**	**6,263**	**5,848**	**5,631**	**5,549**	**5,247**	**4,313**	**5,010**	**4,093**	**4,856**	**−3**	**nc**
THERMOPLASTIC RESINS													
Polyethylene													
Low density[f]	9,695	10,397	9,599	8,903	8,889	8,413	8,041	7,503	7,693	7,291	7,793	−7	2
High density[g]	8,102	8,400	7,995	7,182	6,671	6,085	5,689	4,928	4,695	4,405	5,010	−4	5
Polypropylene	7,238	7,274	6,647	5,812	5,139	4,940	4,433	3,477	3,955	3,648	3,841	0	7
Styrene polymers													
Polystyrene	5,104	5,187	4,780	4,470	4,054	3,838	3,570	3,191	3,621	3,521	4,005	−2	2
Styrene-acrylonitrile	113	148	126	92	87	99	93	91	107	111	124	−24	−1
Acrylonitrile-butadiene-styrene and other styrene polymers[h]	2,394	2,418	2,254	2,196	2,036	2,127	1,889	1,380	1,745	1,705	2,107	−1	1
Polyamide, nylon type	569	566	507	465	399	396	321	228	312	274	327	1	6
Vinyl resins													
Polyvinyl chloride and copolymers	8,478	8,350	7,971	7,256	6,772	6,760	6,067	5,326	5,707	5,470	6,119	2	3
Other vinyl resins[i]	220	222	212	195	190	187	186	177	208	196	220	−1	0
Thermoplastic polyester	1,630	1,652	1,394	1,175	965	899	778	648	609	na	na	−1	na
TOTAL	**43,543**	**44,614**	**41,485**	**37,746**	**35,202**	**33,744**	**31,067**	**26,949**	**28,652**	**26,621**	**29,546**	**−2%**	**4%**

Note: Totals are for those products listed and exclude some small-volume plastics. a Dry-weight basis unless otherwise specified. b Unmodified. c Includes other tar acid resins. d Gross-weight basis. e Unsaturated. f Density 0.940 and below. g Density above 0.940. h Includes styrene-butadiene copolymers and other styrene-based polymers. i Includes polyvinyl butyral, polyvinyl formal, and polyvinylidene-chloride. na = not available. nc = not comparable. **Source:** Society of the Plastics Industry

Fertilizer consumption



Note: Years ending June 30. **Sources:** Department of Agriculture, Fertilizer Institute

FERTILIZERS: Consumption held steady for major nutrients in 1989 crop year

	Consumption											Annual change	
Thousands of tons	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1988–89	1979–89
Nitrogen (N)	10,633	10,475	10,210	10,424	11,493	11,092	9,127	10,983	11,924	11,407	10,715	2%	0%
Phosphates (P_2O_5)	4,124	4,112	4,013	4,178	4,658	4,901	4,138	4,814	5,434	5,432	5,606	0	−3
Potash (K_2O)	4,833	4,943	4,852	5,053	5,553	5,797	4,831	5,631	6,320	6,245	6,245	−2	−3
Total	**19,590**	**19,530**	**19,214**	**19,655**	**21,704**	**21,790**	**18,096**	**21,428**	**23,678**	**23,083**	**22,565**	**0%**	**−1%**

Note: Years end June 30. **Source:** Fertilizer Institute

FERTILIZER PRODUCTION: Phosphates output rose while several nitrogen products declined

								Annual change	
Thousands of tons	1989	1988	1987	1986	1985	1984	1983	1988–89	1983–89
NITROGEN PRODUCTS									
Ammonia	14,192	14,136	13,357	12,565	16,594	16,613	13,361	0%	1%
Ammonium nitrate	2,528	2,765	2,472	2,250	3,178	3,365	3,232	−9	−4
Ammonium sulfate	2,327	2,260	2,153	2,058	2,343	2,078	1,969	3	3
Urea	4,253	4,501	4,253	3,564	3,975	4,889	4,112	−6	1
Nitrogen solutions	5,644	6,999	5,988	5,945	7,928	7,999	6,385	−19	−2
PHOSPHATE PRODUCTS									
Diammonium phosphate	13,507	11,575	9,537	7,492	10,800	12,358	10,264	17	5
Monoammonium phosphate	1,991	1,818	1,679	1,416	1,641	1,654	1,423	10	6
Concentrated superphosphate	1,777	2,032	2,049	2,127	2,570	2,404	2,684	−13	−7
Phosphate rock	47,676	42,220	39,330	36,227	49,348	47,465	40,664	13	3
Phosphoric acid (P_2O_5)	10,962	10,234	8,903	8,085	9,837	10,899	9,182	7	3
POTASH PRODUCTS									
Potassium chloride	2,316	2,243	1,810	1,715	1,713	2,168	1,928	3	3

Note: Figures are based on Fertilizer Institute surveys and may not represent the entire industry. **Source:** Fertilizer Institute

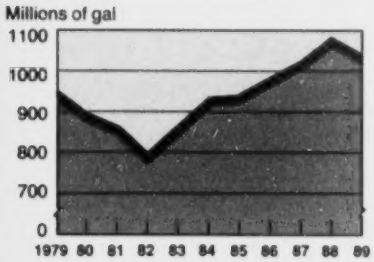
CIRCLE 45 ON READER SERVICE CARD

PESTICIDES: Overall production grew strongly last year, led by major gains for herbicides

Millions of lb	Production											Annual change	
	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1978	1987–88	1979–88
Herbicides[a]	702	556	725	756	716	604	623	839	806	657	664	26%	1%
Insecticides[b]	352	379	342	370	350	306	379	448	506	617	605	−7	−5
Fungicides[c]	110	105	113	109	123	106	111	143	156	155	148	5	−3
TOTAL	**1164**	**1040**	**1180**	**1235**	**1189**	**1017**	**1113**	**1430**	**1468**	**1429**	**1416**	**12%**	**−2%**

a Includes plant growth regulators. b Includes rodenticides, soil conditioners, and fumigants. c Includes dithiocarbamates. **Source:** International Trade Commission

Paints and coatings shipments



COATINGS: Volume down in 1989 after six years of steady growth

Millions of gal	Shipments											Annual change	
	1989[a]	1988[a]	1987	1986	1985	1984	1983	1982	1981	1980	1979	1988–89	1979–89
Architectural	533	532	527	501	477	457	433	374	417	439	472	0%	1%
Product[b]	337	393	340	350	317	336	294	280	312	316	351	−14	0
Special purpose	167	162	145	136	145	145	130	129	129	135	116	3	4
TOTAL	**1037**	**1086**	**1013**	**987**	**939**	**938**	**857**	**783**	**858**	**890**	**939**	**−5%**	**1%**

a Preliminary. b For original equipment manufacturers. **Source:** Department of Commerce

AEROSOLS: Decline in personal products volume offsets gains in other areas

Millions of units	Production											Annual change	
	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1988–89	1979–89
Personal products	1015	1100	964	952	879	832	747	628	645	637	772	−8%	3%
Household products	680	650	640	635	630	603	586	556	575	580	653	5	0
Automotive and industrial products	475	440	379	375	342	337	303	286	302	310	300	8	5
Paints and finishes	350	331	307	297	290	307	300	295	313	310	302	6	1
Insect sprays	197	190	190	193	190	184	180	166	173	150	199	4	0
Food products	175	157	140	136	140	138	132	131	145	130	141	11	2
Animal products	8	8	22	22	15	16	19	19	14	15	18	0	−8
Miscellaneous	12	31	80	18	23	15	15	13	28	30	14	−61	−2
TOTAL	**2912**	**2907**	**2722**	**2628**	**2509**	**2432**	**2282**	**2094**	**2195**	**2162**	**2399**	**0%**	**2%**

Source: Chemical Specialties Manufacturers Association

CHLOROFLUOROCARBONS: Production drops for all major types

Millions of lb	Production											Annual change	
	1989[a]	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1988–89	1979–89
Chlorodifluoromethane (F-22)	327	333	275	271	235	254	236	174	252	227	211	−2%	4%
Dichlorodifluoromethane (F-12)	392	414	335	322	302	337	290	258	325	295	294	−5	3
Trichlorofluoromethane (F-11)	193	249	198	202	176	185	215	140	163	158	167	−22	1
All other fluorinated hydrocarbons[b]	na	379	354	344	306	337	279	na	na	na	202	na	na
TOTAL	**na**	**1374**	**1162**	**1139**	**1019**	**1113**	**1020**	**na**	**na**	**na**	**874**	**na**	**na**

a Preliminary. b Includes other fluorohalogenated hydrocarbons. na = not available. **Source:** International Trade Commission

CIRCLE 45 ON READER SERVICE CARD

Earnings growth stalls for chemical industry

Nobody expected expansion in the chemical industry to last forever. So after profits increased for six of the past seven years—frequently at rates in the double digits—it was no surprise that the heady pace should slow last year. However, the change in trend was nowhere near so bad as many industry observers had feared it might be. And all signs so far this year point to another round of highly respectable profits.

Last year started off looking like a continuation of good times. Prices and production were holding up well enough to continue strong earnings growth through the first quarter. But by the year's second three months, growth had moderated considerably. By the third quarter, declines started showing up in year-to-year comparisons. Then the final period turned the earlier record upside down, with chemical companies registering declines in earnings in the range of 30%.

The result was that while sales continued to increase—up almost 6% for the full year for the 30 companies regularly sampled by C&EN—earnings during all of 1989 for these firms declined about 6% from the previous year. However, despite the drop, chemical company earnings, as tallied by C&EN, were still far higher last year than any year prior to 1988.

The same pattern held true for profitability. Although both profit margins and returns on equity fell last year from the year before, these two measures of company financial performance were higher in 1989 than anytime other than 1988 since 1975. The average profit margin for C&EN's 30-company sample fell to 8.6% of sales in 1989 from 9.6% the year before. And return on stockholders' equity dropped to 20.2% from 23.5% in 1988.

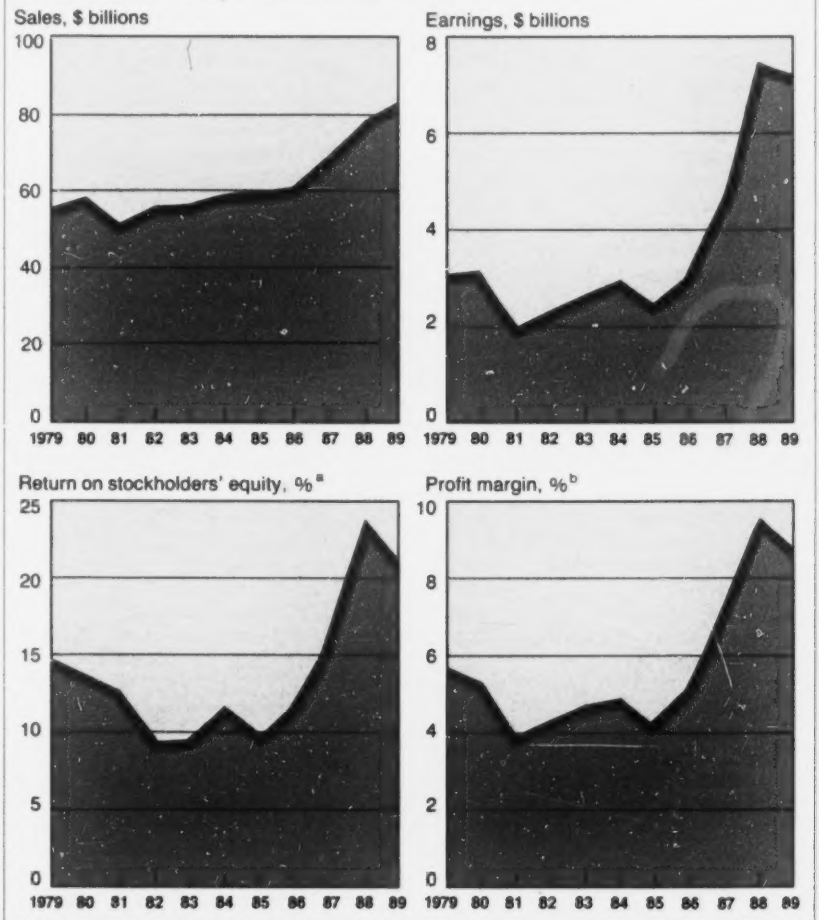
The underlying reason for this decline was largely—but not entirely—a continued weakness in such major markets for chemicals as housing, automobiles and other consumer durable goods, and agriculture.

Softness in these areas led to an increase in chemical production of merely 3% over 1988. And prices, although rising almost 6% for the year as a whole, were slipping significantly during the latter part of 1989. By the end of the year, the producer price index for chemicals and allied products was down 2% from the level where it started the year.

Industry analysts note, too, that while exports of chemicals remained at a high level, the prices that producers were garnering for those exports dropped considerably.

Also contributing to a decline in earnings last year was an increase in debt service costs for many chemical companies. As firms finally began plant expansions, they took on an increased debt load, which resulted in higher interest payments and other charges that ate into earnings.

As the upsurge in earnings ends, profitability is trimmed for major chemical firms



Note: Based on data for 30 major chemical companies. a After-tax earnings as a percentage of year-end stockholders' equity. b After-tax earnings as a percentage of sales.

TOP 100 CHEMICAL PRODUCERS: Half of them sold $1 billion or more of chemicals last year

Rank 1989	Rank 1988		Chemical sales 1989 ($ millions)	Change from 1988	Chemical sales as % of total sales	Industry classification	Chemical operating profits[a] ($ millions)	Change from 1988	Chemical operating profits as % of total profits	Operating profit margin[b]	Identifiable chemical assets ($ millions)	Chemical assets as % of total assets	Operating return on chemical assets[c]
1	1	Du Pont	$15,249	3.6%	42.9%	Diversified	$2769	6.0%	57.0%	18.2%	$12,514	36.0%	22.1%
2	2	Dow Chemical	14,179	4.0	80.6	Basic chemicals	3543	−2.5	88.4	25.0	12,202	55.0	29.0
3	3	Exxon	10,559	5.7	11.1	Petroleum	1609	−13.6	19.2	15.2	7,118	8.6	22.6
4	4	Union Carbide	7,962[d]	4.7	91.1	Basic chemicals	1225	−20.6	96.5	15.4	6,172	72.2	19.8
5	5	Monsanto	5,782	4.5	66.6	Basic chemicals	929	2.1	86.2	16.1	4,482	52.1	20.7
6	6	Hoechst Celanese	5,658	5.4	94.0	Basic chemicals	576	2.3	114.7	10.2	na	na	na
7	7	Occidental Petroleum	5,203	11.3	25.9	Petroleum	1235	17.6	260.0	23.7	5,508	26.6	22.4
8	12	General Electric	4,929[d]	39.3	9.0	Diversified	1057	44.2	15.5	21.4	8,023	6.3	13.2
9	8	BASF	4,461	6.0	82.3	Basic chemicals	na	na	na	na	na	na	na
10	9	Amoco	4,274	−1.8	17.8	Petroleum	744	−27.2	21.6	17.4	3,158	10.4	23.6
11	10	Mobil	4,039	−5.6	7.3	Petroleum	774	−9.0	16.8	19.2	2,702	6.9	28.6
12	11	Shell Oil	3,833	−4.3	16.2	Petroleum	941	26.1	37.9	24.5	3,824	13.9	24.6
13	15	Eastman Kodak	3,522	16.1	19.1	Photo equipment	643	2.4	40.4	18.3	3,238	13.7	19.9
14	13	Chevron	3,328	3.9	10.4	Petroleum	532	−13.6	29.5	16.0	2,476	7.3	21.5
15	14	W. R. Grace	3,256	4.0	53.2	Specialty chemicals	406	4.6	66.0	12.5	2,436	43.4	16.7
16	16	Allied-Signal	2,903	−1.3	25.1	Diversified	355	−5.8	37.5	11.9	1,879	18.5	18.9
17	17	Arco Chemical	2,663	−1.4	100.0	Basic chemicals	580	−19.7	100.0	21.8	2,655	100.0	21.8
18	18	Rohm & Haas	2,661	5.0	100.0	Basic chemicals	287	−23.9	100.0	10.8	2,128	86.7	13.5
19	20	Air Products[e]	2,481	10.9	93.9	Basic chemicals	425	3.8	109.5	17.1	2,835	84.2	15.0
20	19	Phillips Petroleum	2,449	−2.7	19.8	Petroleum	652	−28.4	46.9	26.6	1,377	12.2	47.3
21	23	Bayer USA	2,300	7.5	42.4	Diversified chemicals	127[f]	7.6	82.5	5.5	na	na	na
22	22	American Cyanamid	2,241	3.4	46.4	Basic chemicals	236	10.0	40.7	10.5	1,779	35.8	13.2
23	24	Ashland Oil[e]	2,230	6.7	26.3	Petroleum	98	−3.9	34.8	4.4	744	16.7	13.2
24	21	Quantum Chemical	2,015	−9.2	75.4	Basic chemicals	423	−40.5	89.0	21.0	1,830	60.9	23.1
25	25	B. F. Goodrich	1,977	−4.7	81.7	Basic chemicals	261	−15.4	95.0	13.2	1,467	64.5	17.8
26	—	Lyondell Petrochemical	1,905	0.1	35.6	Petroleum	na	na	na	na	na	na	na
27	28	Texaco	1,818	6.3	5.6	Petroleum	399	5.3	11.6	21.9	1,126	4.4	35.4
28	—	Atochem	1,778	206.0	100.0	Basic chemicals	na	na	na	na	na	na	na
29	38	Aluminum Co. of America	1,700	39.9	15.6	Nonferrous metals	na	na	na	na	2,500	21.7	0
30	27	Hercules	1,632	−4.2	52.8	Basic chemicals	126	−0.8	62.5	7.7	1,294	35.4	9.7
31	37	Akzo	1,612	19.7	100.0	Basic chemicals	117	54.4	100.0	7.3	na	na	na
32	35	Rhône-Poulenc	1,600	14.3	100.0	Specialty chemicals	na	na	na	na	na	na	na
33	32	Dow Corning	1,575	6.6	100.0	Specialty chemicals	163[f]	8.2	100.0	10.3	na	na	na
34	34	National Starch	1,569	10.9	100.0	Specialty chemicals	226	13.2	100.0	14.4	1,269	100.0	17.8
35	33	FMC	1,542	7.4	45.1	Machinery	220	−1.5	55.5	14.3	1,329	47.1	16.6
36	30	Ethyl	1,520	−9.2	62.5	Basic chemicals	283	−8.5	69.4	18.6	1,055	18.7	26.8
37	31	BP America	1,426	−5.4	8.1	Petroleum	68	−34.6	3.3	4.8	na	na	na
38	36	Olin	1,285	−5.9	51.2	Basic chemicals	174	65.7	76.7	13.5	936	49.2	18.6
39	39	Unocal	1,276	6.0	11.6	Petroleum	74	−59.3	12.8	5.8	622	6.7	11.9
40	—	Tenneco	1,224	0.5	8.7	Petroleum	119	−1.7	8.5	9.7	1,229	7.2	9.7
41	44	IMC Fertilizer[g]	1,222	12.5	100.0	Agrochemicals	257	17.7	100.0	21.1	1,678	100.0	15.3
42	40	Huntsman Chemical	1,200	0	100.0	Basic chemicals	na	na	na	na	na	na	na
42	43	Ciba-Geigy	1,200[h]	9.3	34.3	Specialty chemicals	na	na	na	na	na	na	na
44	42	PPG Industries	1,175	5.6	20.5	Glass products	257	0.8	35.2	21.9	1,033	18.3	24.9
45	47	Lubrizol	1,124	8.5	92.1	Specialty chemicals	321	4.8	90.2	28.5	733	76.3	43.8
46	41	Freeport-McMoRan	1,105	−2.3	95.6	Agrochemicals	108	−45.3	82.1	9.8	876	72.2	12.3
46	46	Georgia Gulf	1,105	4.1	100.0	Basic chemicals	300	−3.9	100.0	27.2	473	100.0	63.4
48	51	Nalco Chemical	1,071	7.7	100.0	Specialty chemicals	181	14.1	100.0	16.9	939	100.0	19.3
49	49	NL Industries	1,001	−0.6	100.0	Basic chemicals	278	6.5	100.0	27.8	na	na	na
50	50	Solvay America	1,000[d]	0	100.0	Basic chemicals	na	na	na	na	na	na	na

2 Finances of the U.S. Chemical Industry

Rank 1989	Rank 1988	Company	Chemical sales 1989 ($ millions)	Change from 1988	Chemical sales as % of total sales	Industry classification	Chemical operating profits[a] ($ millions)	Change from 1988	Chemical operating profits as % of total profits	Operating profit margin[b]	Identifiable chemical assets ($ millions)	Chemical assets as % of total assets	Operating return on chemical assets[c]
51	45	Aristech	$996	−6.5%	100.0%	Basic chemicals	$140	−28.9%	100.0%	14.0%	$ 721	100.0%	19.4%
52	54	Cabot[e]	951	5.2	49.1	Basic chemicals	112	−31.6	176.7	11.7	790	55.7	14.1
53	56	Terra Chemicals	949	11.9	100.0	Agrochemicals	na	na	na	na	na	na	na
54	55	Morton International[g]	935	7.0	66.5	Specialty chemicals	144	−3.0	69.6	15.4	861	63.1	16.8
55	60	Farmland Industries[i]	903	17.7	30.3	Agricultural supplies	90	20.3	50.6	10.0	382	32.3	23.6
56	—	Degussa	886	na	51.4	Specialty chemicals	na	na	na	na	na	na	na
57	57	International Flavors	870	3.6	100.0	Specialty chemicals	223	6.6	100.0	25.7	684	70.6	32.6
58	52	CF Industries	856	−10.6	100.0	Agrochemicals	27	−75.1	100.0	3.2	798	100.0	3.4
59	63	Engelhard	813	11.9	33.8	Diversified	96	−10.3	79.0	11.8	888	66.3	10.8
60	62	Uniroyal Chemical	805	9.6	100.0	Specialty chemicals	na	na	na	na	na	na	na
61	68	Great Lakes Chemical	792	42.0	100.0	Specialty chemicals	202	40.6	100.0	25.5	1,097	100.0	18.4
62	59	Vista Chemicals[e]	779	−0.3	100.0	Basic chemicals	227	16.8	100.0	29.2	567	100.0	40.1
63	—	Nova	778	44.3	100.0	Basic chemicals	na	na	na	na	na	na	na
64	61	Witco	766[h]	1.0	48.2	Specialty chemicals	18	−71.4	24.2	2.3	377	33.1	4.7
65	65	H. B. Fuller[j]	753	10.0	100.0	Specialty chemicals	46	−0.9	100.0	6.1	455	100.0	10.1
66	66	American Petrofina	662	−2.9	21.8	Petroleum	138	−50.7	69.4	20.9	435	17.3	31.9
67	53	International Minerals[g]	640	−31.3	65.1	Agrochemicals	50	−57.4	37.7	7.8	673	34.1	7.4
68	70	GAF	600	10.1	59.4	Specialty chemicals	171	13.9	93.9	28.5	na	na	na
69	71	Kerr-McGee	592	14.3	19.2	Petroleum	125	22.5	40.7	21.1	794	23.8	15.7
70	64	Sterling Chemical[e]	581	−16.9	100.0	Basic chemicals	156	−49.9	100.0	26.9	329	100.0	47.5
71	—	Atlas Powder	543	11.9	100.0	Explosives	na	na	na	na	na	na	na
72	77	Betz Laboratories	517	15.4	100.0	Specialty chemicals	88	15.1	100.0	16.9	369	100.0	23.7
73	75	Sun Co.	510	10.6	4.6	Petroleum	na	na	na	na	na	na	na
74	72	Pfizer	509	−0.6	9.0	Drugs	39	−20.2	4.1	7.7	538	6.5	7.2
75	76	Hoffmann-La Roche	500[k]	11.1	22.7	Drugs	na	na	na	na	na	na	na
76	74	Merck	492	5.6	7.5	Drugs	59	−3.6	2.7	12.0	470	7.0	12.6
77	78	Ferro	478	7.8	44.1	Specialty materials	17	−6.0	18.2	3.6	251	37.5	6.8
78	69	Borden Chemicals	466	−15.7	100.0	Basic chemicals	95	−39.0	99.7	20.4	550	100.0	17.3
79	80	Loctite[g]	457	9.5	100.0	Specialty chemicals	80	21.1	100.0	17.5	362	100.0	22.0
80	82	Lonza	450	13.9	100.0	Specialty chemicals	na	na	na	na	na	na	na
81	79	Dexter	439	3.4	51.7	Specialty chemicals	31	20.5	33.1	7.1	310	44.6	10.1
82	83	Vulcan Materials	430	12.5	40.0	Nonmetallic minerals	86	30.7	42.9	20.1	na	na	na
83	81	Union Camp	413	3.7	15.0	Diversified	14	−54.8	2.7	3.3	289	8.5	4.7
84	85	Sigma-Aldrich	359	18.9	81.4	Specialty chemicals	87	12.8	86.9	24.2	418	88.5	20.7
85	84	Stepan	346	4.0	100.0	Specialty chemicals	12	−43.1	100.0	3.4	215	100.0	5.4
86	89	First Mississippi[g]	308	29.5	70.9	Agrochemicals	27	16.0	82.3	8.7	166	34.7	16.2
87	90	Crompton & Knowles	281	20.9	79.0	Specialty chemicals	36	37.0	71.4	12.9	170	78.2	21.2
88	87	Chemed	277	2.7	52.3	Specialty chemicals	38	14.3	67.4	13.8	137	40.7	28.0
89	86	Petrolite[i]	275	0.2	94.3	Specialty chemicals	19	−12.3	217.6	6.7	191	79.6	9.7
90	91	Calgon Carbon	253	12.1	100.0	Basic chemicals	57	10.8	100.0	22.4	234	100.0	24.3
90	88	Georgia-Pacific	253	5.0	2.5	Wood products	na	na	na	na	na	na	na
92	93	Mississippi Chemical[g]	209	12.4	100.0	Farm cooperative	47	157.7	100.0	22.5	577	100.0	8.1
93	92	Sherex	188	−6.0	100.0	Specialty chemicals	na	na	na	na	na	na	na
94	94	Quaker Chemical	182	9.0	100.0	Specialty chemicals	23	32.5	100.0	12.7	109	83.3	21.0
95	95	LeaRonal[m]	157	0	100.0	Specialty chemicals	16	15.2	100.0	10.3	88	100.0	18.3
96	—	Nu-West[g]	155	176.3	100.0	Agrochemicals	−3	def	def	def	170	100.0	def
97	—	Eagle-Picher	152[d]	−21.3	20.9	Diversified	15	−35.1	36.9	9.7	86	17.8	17.3
98	96	Lawter International	136	8.1	100.0	Specialty chemicals	23	−17.8	100.0	16.5	134	100.0	16.8
99	99	Cambrex Corp.	131	8.9	100.0	Specialty chemicals	7	−48.6	100.0	5.0	129	100.0	5.1
100	98	Agway	118[k]	−4.3	3.7	Farm cooperative	na	na	na	na	na	na	na

a Operating income is sales less administrative expenses and cost of sales. b Chemical operating profit as a percentage of chemical sales. c Chemical operating profit as a percentage of identifiable chemical assets. d Chemical sales include significant amounts of nonchemical products. e Fiscal year ended Sept. 30. f Chemical net income. g Fiscal year ended June 30. h Does not include all chemical sales. I Fiscal year ended Aug. 31. j Fiscal year ended Nov. 30. k C&EN estimate. l Fiscal year ended Oct. 31. m Fiscal year ended Feb. 28, 1989.

FINANCIAL ANALYSIS: By several measures, chemical company performance declined in 1989

		Profit margin[a]	Return on investment[b]	Debt as % of debt plus equity	% total sales abroad[c]	% total assets abroad[d]	Sales per employee[e]	Dividends as % of net income	CAPITAL SPENDING[f] as % of sales	CAPITAL SPENDING[f] as % of net plant	R&D as % of sales	Sales as % of assets	Net plant as % of gross plant
SALES OVER $1 BILLION													
Air Products[g]	1989	8.4%	4.3%	37.1%	23.6%	30.8%	$187	31.2%	15.7%	18.7%	2.7%	78.5%	49.9%
	1988	8.8	4.5	34.4	24.0	29.9	183	28.2	16.8	19.9	3.0	81.1	50.5
American Cyanamid	1989	6.1	5.0	16.5	38.6	24.6	136	41.1	8.2	22.6	8.4	97.1	51.4
	1988	6.7	5.6	18.9	38.3	24.3	129	34.1	8.1	24.0	8.0	100.0	49.8
Cabot[g]	1989	0.9	1.0	44.1	32.8	12.7	352	166.1	9.9	25.9	1.8	136.7	56.1
	1988	3.6	3.8	34.5	36.8	9.6	322	40.5	10.1	20.3	1.7	108.6	52.1
Dow Chemical	1989	14.1	10.1	32.6	54.1	44.9	283	23.2	9.6	22.2	5.0	79.4	44.1
	1988	14.4	11.1	31.5	55.1	53.5	301	19.1	10.0	25.4	4.6	102.7	42.8
Ethyl	1989	14.4	13.2	35.6	31.3	3.8	276	26.3	7.8	20.5	4.0	27.0	48.8
	1988	11.5	11.0	35.0	21.5	3.6	193	22.5	7.5	21.0	2.9	38.3	49.3
Georgia Gulf	1989	17.4	35.3	66.1	na	na	818	12.5	4.9	25.9	na	233.5	69.7
	1988	18.3	38.3	14.2	na	na	776	8.6	2.4	14.8	na	231.9	69.0
B. F. Goodrich	1989	7.1	6.3	18.5	26.7	18.6	203	34.6	9.9	24.2	2.7	106.4	59.6
	1988	8.7	8.1	21.1	28.4	18.5	196	24.8	7.5	19.3	2.4	116.6	58.3
W. R. Grace	1989	4.2	3.9	48.6	34.8	31.0	132	46.6	7.9	21.8	2.0	108.8	49.6
	1988	4.0	3.8	49.3	37.0	28.6	127	52.1	7.2	20.6	2.1	109.0	49.8
Hercules	1989	def	def	23.3	25.4	17.0	133	def	9.5	20.7	2.5	84.6	48.4
	1988	4.3	3.1	17.3	22.6	13.3	123	77.1	9.0	21.6	2.7	84.3	49.6
Lubrizol	1989	7.7	6.9	7.4	52.4	40.3	230	54.8	5.3	20.4	5.7	127.1	39.0
	1988	11.7	10.1	7.7	53.6	35.1	234	48.0	4.9	18.3	5.8	115.1	40.8
Monsanto	1989	7.8	6.7	27.2	35.6	28.5	206	32.5	7.0	19.1	6.9	100.9	45.7
	1988	7.1	5.9	27.0	37.1	27.4	182	35.7	7.1	18.8	7.8	98.0	45.4
Morton International[h]	1989	6.9	6.5	4.6	31.1	26.4	167	na	9.4	23.8	2.7	103.1	59.7
	1988	9.3	9.2	5.5	30.0	30.3	160	na	7.8	20.4	2.8	105.9	59.1
Nalco Chemical	1989	11.2	10.8	32.5	27.1	19.4	195	47.9	8.1	24.6	3.8	114.1	48.7
	1988	10.7	10.8	17.4	27.8	20.4	185	47.6	6.2	19.8	3.7	118.5	48.0
Olin	1989	4.9	4.2	36.1	7.2	9.3	163	34.7	5.7	18.2	2.6	131.8	36.0
	1988	4.2	3.3	33.8	10.1	9.2	141	36.7	6.4	18.4	2.5	119.0	37.0
PPG Industries	1989	8.1	6.2	33.3	30.9	29.7	162	35.6	9.4	17.9	4.1	101.6	55.2
	1988	8.3	6.8	27.2	30.0	28.8	155	30.0	7.3	14.9	4.0	109.0	55.1
Quantum	1989	4.3	3.4	107.9	na	na	na	1121.1	21.8	33.2	1.7	88.9	70.0
	1988	12.3	11.0	144.0	na	na	na	17.4	11.4	25.5	na	100.5	67.4
Rohm & Haas	1989	6.6	5.2	21.5	43.2	32.1	204	43.8	14.5	33.5	6.6	108.4	47.9
	1988	9.1	7.4	19.3	42.8	30.2	204	29.1	13.3	36.1	6.2	113.1	45.3
Union Carbide	1989	6.6	4.7	46.6	33.7	40.7	190	24.4	9.0	17.1	2.1	102.3	48.1
	1988	8.0	5.6	55.6	30.8	36.9	189	23.4	8.1	15.2	1.9	98.6	49.0
Witco	1989	2.2	2.3	29.2	18.9	16.4	216	103.3	4.4	16.9	1.6	139.4	48.3
	1988	4.5	4.9	29.4	19.5	15.1	209	43.5	4.5	18.0	1.5	142.3	48.7
MEDIAN 1989		6.9%	5.2%	32.6%	31.3%	26.4%	$199	35.2%	9.0%	21.8%	2.7%	103.1%	48.8%
MEDIAN 1988		8.7%	6.8%	27.2%	30.0%	27.4%	$184	32.1%	7.5%	19.9%	2.9%	108.6%	49.6%

2 Finances of the U.S. Chemical Industry

		Profit margin[a]	Return on investment[b]	Debt as % of debt plus equity	% total sales abroad[c]	% total assets abroad[d]	Sales per employee[e]	Dividends as % of net income	CAPITAL SPENDING[f] as % of sales	CAPITAL SPENDING[f] as % of net plant	R&D as % of sales	Sales as % of assets	Net plant as % of gross plant
SALES LESS THAN $1 BILLION													
Betz Laboratories	1989	10.8%	12.1%	35.2%	17.8%	18.9%	$151	55.4%	10.2%	30.7%	3.7%	139.9%	54.6%
	1988	10.8	12.2	0.0	18.0	20.0	142	50.8	9.7	28.4	3.6	140.5	55.7
Calgon Carbon	1989	13.9	13.3	9.9	37.3	30.7	191	12.5	10.4	25.8	1.9	108.4	75.5
	1988	13.0	13.6	18.3	34.4	35.1	na	7.1	7.1	18.7	2.0	115.2	77.7
Cambrex	1989	2.3	2.3	20.3	17.5	na	na	9.1	5.8	15.4	2.9	101.9	68.6
	1988	5.8	6.0	6.7	17.6	na	na	0.0	6.3	19.7	2.6	107.4	68.4
Chemed	1989	4.9	9.8	41.5	11.0	11.8	93	70.6	2.7	21.4	0.6	158.1	56.5
	1988	4.7	8.3	44.8	12.7	11.1	80	77.3	3.3	24.0	0.7	137.4	58.0
Crompton & Knowles	1989	6.9	11.2	29.4	17.3	21.5	212	27.9	3.8	26.4	2.2	163.3	56.1
	1988	5.8	8.4	35.2	18.4	21.2	181	30.1	2.4	16.1	2.1	140.9	55.4
First Mississippi[h]	1989	3.8	2.1	30.6	17.7	na	na	34.6	24.7	38.2	na	90.8	44.8
	1988	10.2	5.7	1.8	25.1	na	na	14.8	19.0	36.2	na	96.3	35.2
H. B. Fuller[i]	1989	2.1	3.1	35.1	44.9	50.8	140	34.9	5.4	21.9	2.1	165.5	63.5
	1988	3.1	4.5	35.5	46.3	50.1	132	23.7	5.9	24.9	2.1	157.7	63.4
Great Lakes Chemical	1989	15.5	13.2	16.1	40.1	49.6	na	11.1	5.1	14.7	3.4	72.2	56.6
	1988	18.5	16.3	3.8	17.9	12.8	na	11.8	8.4	20.1	3.4	84.0	57.3
International Flavors	1989	15.9	11.9	0.0	69.2	47.0	206	52.6	3.8	14.1	6.0	89.7	53.1
	1988	15.3	12.1	0.0	70.1	48.0	201	47.1	4.8	17.6	5.9	95.2	55.1
International Minerals[h]	1989	11.2	7.1	44.5	25.8	10.4	142	33.5	8.4	17.1	6.6	49.9	69.5
	1988	7.1	7.1	25.9	17.3	14.5	213	41.0	5.5	18.2	4.4	82.0	71.1
Loctite[h]	1989	11.9	14.0	13.8	57.9	62.0	130	26.4	3.5	22.8	3.8	126.1	53.7
	1988	10.0	11.4	16.1	58.4	62.2	127	23.7	3.5	19.8	3.5	120.2	57.1
Petrolite[i]	1989	2.4	2.0	1.1	30.5	35.0	na	178.1	6.5	18.0	4.1	121.5	44.0
	1988	4.3	3.7	2.2	30.2	34.3	na	97.5	6.8	19.6	4.1	124.7	44.7
Quaker	1989	7.1	8.9	5.9	43.4	32.1	185	29.8	4.2	20.7	na	138.2	53.0
	1988	7.0	8.9	5.7	40.6	30.7	170	29.6	3.2	16.1	5.5	137.6	52.9
Sigma-Aldrich	1989	14.5	12.0	17.1	21.9	26.4	116	14.3	11.7	29.3	na	93.4	71.3
	1988	15.0	13.9	6.0	18.0	15.4	117	14.4	9.5	29.8	na	104.3	68.6
Stepan	1989	2.3	2.3	49.2	na	na	301	37.2	9.8	27.8	2.9	160.8	48.7
	1988	4.0	4.6	40.5	na	na	324	19.8	6.1	19.5	3.9	179.4	47.9
Sterling Chemical[g]	1989	17.9	28.6	37.6	35.0	na	na	42.5	9.9	26.6	na	176.5	84.7
	1988	30.6	67.7	46.8	na	na	na	89.0	2.4	9.8	na	237.6	86.7
Vista Chemical[g]	1989	15.4	18.2	141.7	3.4	na	na	20.7	12.7	29.0	na	137.4	71.0
	1988	15.9	21.1	60.2	9.8	na	na	4.3	6.2	17.4	na	150.0	72.0
MEDIAN 1989		10.8%	11.2%	29.4%	26.2%	31.4%	$151	33.5%	6.5%	22.8%	3.2%	126.1%	56.5%
MEDIAN 1988		10.0	8.9	16.1	18.4	26.0	$156	23.7	6.1	19.6	3.5	124.7	57.3

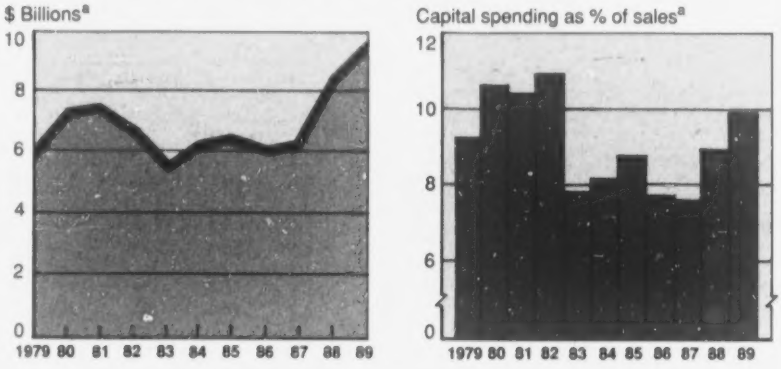
Note: Net income is from continuing operations, excluding extraordinary and nonrecurring items where possible. a Net income as a percentage of sales. b Net income as a percentage of current assets plus gross plant. c Consolidated sales only. d Foreign identifiable assets as a percentage of total assets. e Thousands of dollars. f Actual spending on construction of new facilities and purchase of land and new equipment in consolidated businesses. g Fiscal year ended Sept. 30. h Fiscal year ended June 30. i Fiscal year ended Nov. 30. j Fiscal year ended Oct. 31. **na** = not available. **def** = deficit.

2 Finances of the U.S. Chemical Industry

Capital spending by U.S. chemical producers continued to rise at a higher than usual rate in 1989. The increase for 1989 over 1988 for the 25 chemical firms that C&EN surveys annually was 16%, a respectable showing although not nearly so good as the 35% jump that 1988 registered over 1987.

Even so, last year's increase was well above the 5% annual compound growth rate during the past 10 years for the companies whose plant outlays are tabulated by C&EN. Among the 25 firms with notable increases in spending last year were Crompton & Knowles, up 86%;

Chemical capital spending nears $10 billion as it rises to the highest level relative to industry sales since 1982



a Worldwide data for 25 major chemical producers. **Source:** Company data

INDUSTRY CAPITAL SPENDING: Spending on chemical plants expands for the third year

$ Billions	1990[a]	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980
Chemicals	$ 20.75	$ 20.35	$ 19.25	$ 16.42	$ 16.81	$ 16.44	$ 15.32	$ 12.96	$ 12.66	$ 13.11	$ 11.63
Iron and steel	7.52	6.91	6.16	4.69	3.32	4.12	3.54	3.25	3.78	3.48	3.44
Nonferrous metals	3.25	2.91	2.77	2.16	1.93	1.88	2.13	1.74	1.90	2.51	2.13
Paper	17.20	15.69	11.23	9.01	8.77	8.59	7.21	5.92	5.60	6.11	6.52
Petroleum	25.25	22.97	19.93	17.12	17.92	26.71	25.53	23.14	26.39	25.98	19.57
Rubber	4.18	4.51	3.86	3.52	3.89	3.86	3.11	2.46	2.16	2.15	2.03
Stone, clay, glass	3.79	3.90	3.59	3.37	3.14	3.40	3.09	2.77	2.90	3.41	3.98
All manufacturing	190.89	184.54	165.70	145.90	142.69	153.48	138.82	116.20	120.68	126.54	112.33

a Estimate. **Source:** Department of Commerce

Unspent capital appropriations continue to swell

$ Billions	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979
Chemicals	$ 11.9	$ 10.6	$ 7.0	$ 6.2	$ 8.0	$ 7.8	$ 7.5	$ 7.4	$ 9.4	$ 9.8	$ 8.5
Iron and steel	2.9	2.7	1.4	0.5	1.1	2.1	2.2	2.7	5.4	3.9	4.5
Nonferrous metals	2.3	1.6	1.7	1.6	2.3	2.5	3.2	3.2	3.7	3.7	2.9
Paper	17.4	12.3	6.3	4.4	4.3	5.9	4.0	5.1	5.1	4.0	4.2
Petroleum	17.1	14.6	15.2	16.7	26.2	24.7	22.3	22.9	29.7	26.7	16.1
Rubber	3.5	2.8	1.7	1.9	3.1	1.6	1.1	1.0	0.9	1.0	0.9
Stone, clay, glass	2.7	2.8	2.4	1.8	2.0	2.2	1.5	1.6	1.9	2.0	2.3
All manufacturing	114.2	101.7	76.8	69.7	95.0	94.4	73.7	70.8	92.7	91.9	76.7

Note: Figures are for fourth quarter of each year. **Source:** Conference Board

Foreign capital outlays by U.S. chemical companies have doubled since 1986

$ Billions[a]	1990[b]	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980
Chemicals and allied products	$ 6.2	$ 5.3	$ 4.7	$ 3.7	$ 3.1	$ 2.7	$ 2.4	$ 2.3	$ 2.8	$ 3.0	$ 3.0
Metals, primary and fabricated	2.1	1.5	1.1	0.8	0.9	0.9	1.0	0.9	0.9	0.8	0.9
Petroleum	1.56	14.4	13.3	9.8	9.6	13.7	14.1	15.9	19.7	15.8	14.8
All manufacturing	27.4	23.4	20.8	17.2	16.4	14.9	13.6	13.6	16.8	19.2	19.5

a By majority-owned affiliates of U.S. companies. b Planned. **Source:** Department of Commerce

Quantum Chemical, up 75%; Stepan, up 70%; Quaker Chemical, up 60%; Nalco Chemical, up 39%; B. F. Goodrich, up 33%; and Du Pont, up 26%.

As a percentage of sales, capital spending by the 25 companies as a whole was 9.9% last year, up from 8.9% in 1988. The high for the past decade occurred in 1982, when capital expenditures were 10.9% of sales.

The rate of increase showing up in the much more comprehensive survey of capital expenditures by the chemical industry conducted by the Department of Commerce indicates a more conservative annual increase last year of only 6%. If capital spending increases in 1990 as much as the Commerce Department's survey indicates, chemical producers will boost their outlays just 2% further to a total approaching $21 billion. This figure indicates the industry has scaled back its plant investment plans somewhat in the past few months; an earlier Commerce Department survey had pegged outlays by chemical firms during 1990 at a considerably higher $21.8 billion.

A separate survey by the Conference Board, meanwhile, shows that the backlog of unspent funds ticketed for plant expansion by chemical producers was 12% higher at the end of 1989 than a year earlier, rising to nearly $12 billion.

Although the rate of increase in capital spending appears to have declined from the hectic level of 1988, capital expenditures abroad by U.S. chemical companies continue to rise. A Department of Commerce survey shows that overseas affiliates of U.S. chemical producers plan to increase their outlays 17% in 1990 to $6.2 billion, compared with a 13% increase last year over 1988, as U.S. firms' overseas markets and globalization efforts remain strong.

CHEMICAL CAPITAL SPENDING: 1989 was strong year, but increases did not match 1988's

$ Millions	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979
Air Products	$ 414	$ 409	$ 323	$ 367	$ 392	$ 263	$ 246	$ 347	$ 323	$ 364	$ 246
American Cyanamid	398	374	268	263	203	200	165	171	181	196	235
Cabot[a]	192	170	83	80	184	505	80	152	194	137	98
Chemed	14	15	9	9	7	9	5	4	4	4	6
Crompton & Knowles	13	7	4	4	3	3	2	3	7	10	9
Dow Chemical	1695	1670	995	890	806	781	630	829	1176	1184	1268
Du Pont[b]	2536	2029	1674	1587	1515	1319	1276	1300	1420	1297	864
Ethyl	119	151	139	134	90	103	85	92	141	156	123
B. F. Goodrich	240	181	143	144	202	153	115	144	205	184	192
W. R. Grace	485	418	243	199	348	380	353	560	657	658	514
Great Lakes Chemical	40	47	35	18	21	29	20	29	47	21	18
Hercules	293	251	205	257	234	218	168	174	167	229	186
Loctite	16	14	15	9	11	6	10	11	13	14	9
Lubrizol	65	55	42	41	40	30	25	52	75	92	51
Monsanto	607	590	505	520	645	614	560	673	668	781	566
Nalco Chemical	86	62	57	64	60	53	41	56	59	35	39
Olin	142	147	115	128	154	165	123	129	186	172	161
PPG Industries	537	410	426	356	452	315	450	452	376	401	252
Petrolite	19	20	19	25	24	11	9	24	15	17	12
Quaker Chemical	8	5	4	5	6	4	2	2	1	5	3
Quantum Chemical	583	334	154	102	76	116	71	66	44	49	58
Rohm & Haas	385	338	222	179	159	124	72	126	182	93	68
Stepan	34	20	26	14	19	12	10	16	12	9	14
Union Carbide	785	671	502	524	649	670	761	1179	1186	1129	831
Witco	70	72	69	60	76	85	55	54	83	73	49
TOTAL	$9803	$8460	$6277	$5979	$6376	$6168	$5334	$6645	$7422	$7310	$5871
ANNUAL CHANGE	16%	35%	5%	−6%	3%	16%	−20%	−10%	2%	25%	19%

Note: Figures are for worldwide spending on construction, equipment, and land in consolidated businesses. Where possible, acquisition costs and investments in nonconsolidated businesses are excluded. a Includes acquisitions and investments. b Excludes Conoco. **Source:** Company data

2 Finances of the U.S. Chemical Industry

SHIPMENTS: Strong rise for drugs and related products boosts overall chemical total

$ Billions	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	Annual change 1988–89	Annual change 1979–89
All manufacturing industries	$2781.6	$2611.6	$2390.0	$2260.3	2279.1	$2254.4	$2054.9	$1960.2	$2017.5	$1852.7	$1727.2	7%	5%
Chemicals and allied products	255.6	240.5	212.7	197.1	197.3	198.2	183.2	170.7	180.5	162.5	147.7	6	6
Industrial chemicals[a]	68.9	67.8	59.5	54.1	59.6	61.5	56.6	53.2	62.7	57.3	52.3	2	3
Drugs, soap, and toiletries	82.0	73.1	67.1	65.8	60.9	57.5	54.4	50.7	46.9	41.9	36.7	12	8
Petroleum and coal products	138.4	124.2	124.5	124.9	179.1	189.0	192.6	208.9	224.1	198.7	148.4	11	−1
Rubber and plastic products	95.8	91.1	80.5	73.4	71.3	69.5	60.3	55.4	53.2	47.3	46.8	5	7
Paper and allied products	130.4	124.2	110.3	97.9	93.4	94.8	84.6	79.9	80.2	72.8	65.2	5	7

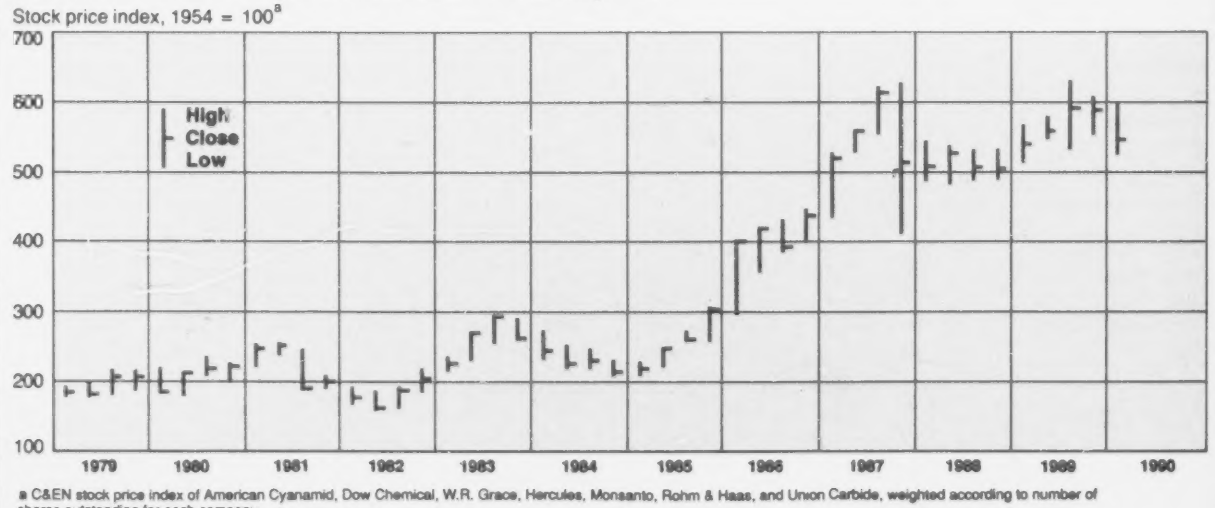
a Excluding pigments. Source: Department of Commerce

PRICES: Most chemical products outpaced other commodities last year

Producer price indexes, 1982 = 100	Annual average 1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	Annual change 1988–89	Annual change 1979–89
All commodities	112.2	106.9	102.8	100.2	103.1	103.7	101.3	100.0	98.0	89.8	78.7	5%	4%
Industrial commodities	111.6	106.3	102.6	99.9	103.7	103.3	101.1	100.0	97.4	88.0	75.7	5	4
Chemicals and allied products	123.1	116.3	106.4	102.5	103.7	102.9	100.2	100.0	98.4	89.1	76.1	6	5
Industrial chemicals	114.8	106.8	95.5	91.5	96.0	96.8	97.3	100.0	103.0	91.9	74.9	7	4
Prepared paint	119.5	112.2	108.1	107.0	105.3	103.7	100.7	100.0	95.0	89.5	77.8	6	4
Paint materials	129.1	115.7	107.3	104.4	109.5	108.2	100.3	100.0	98.5	89.9	79.2	12	5
Drugs and pharmaceuticals	160.0	148.4	139.1	129.9	122.2	114.2	107.7	100.0	92.1	83.1	75.9	8	8
Fats and oils, inedible	95.5	110.9	92.7	80.5	110.6	139.1	106.2	100.0	110.7	111.6	141.1	−14	−4
Agricultural chemicals and chemical products	108.7	104.5	96.4	94.2	96.2	97.4	96.0	100.0	97.5	87.9	73.3	4	4
Plastic resins and materials	133.4	132.4	110.3	104.4	107.5	108.9	102.4	100.0	102.0	98.5	83.2	1	5
Other chemicals and allied products	117.3	111.9	107.0	105.8	105.2	102.7	101.3	100.0	94.1	83.1	71.0	5	5
Rubber and plastic products	112.6	109.3	103.0	101.9	101.9	102.2	100.8	100.0	96.4	90.1	80.5	3	3

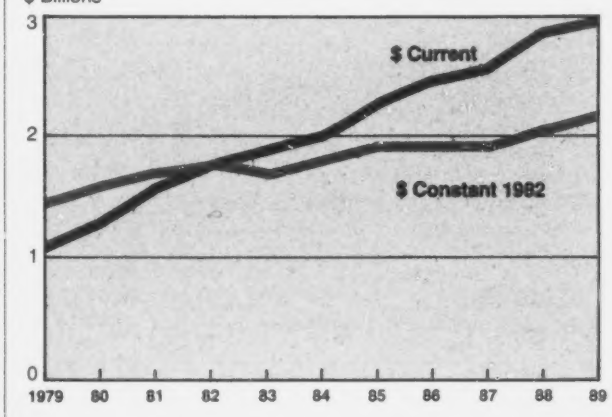
Source: Department of Labor

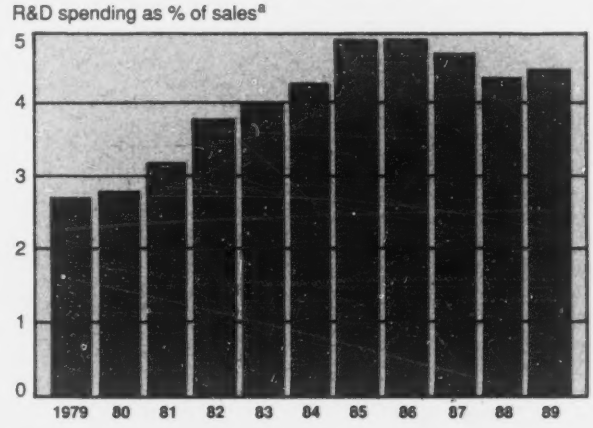
Chemical shares hover a bit below last fall's peak



a C&EN stock price index of American Cyanamid, Dow Chemical, W.R. Grace, Hercules, Monsanto, Rohm & Haas, and Union Carbide, weighted according to number of shares outstanding for each company.

Growth continues but chemical firms' R&D outlays are little changed relative to sales





a R&D spending by 15 major chemical producers. **Sources:** Company data, Battelle Columbus Laboratories

R&D SPENDING: Companies' budgets up relatively modestly in 1989

$ Millions	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979
CHEMICAL COMPANIES											
Air Products[a]	$ 71	$ 72	$ 57	$ 61	$ 51	$ 44	$ 40	$ 37	$ 32	$ 30	$ 24
American Cyanamid	406	365	314	278	251	232	208	185	166	148	130
Dow Chemical	873	772	670	605	547	507	492	460	404	314	269
Ethyl	61[b]	59[b]	50	47	47	40	39	39	37	34	29
W. R. Grace	125	119	107	94	92	81	73	64	57	45	42
Hercules	79	74	74	71	76	72	74	74	65	57	50
International Flavors	52	50	45	39	34	32	32	31	30	29	27
Lubrizol	70	65	62	51	44	33	37	36	33	28	23
Monsanto	598	648	615	596	470	370	290	264	233	208	161
Nalco	41	37	35	33	32	32	30	33	30	28	21
Olin	66	58	62	56	53	52	49	45	38	31	26
Petrolite	12	12	12	12	12	12	13	10	8	7	6
PPG Industries	233	227	227	204	176	150	127	127	119	103	83
Rohm & Haas	175	156	142	133	124	109	100	92	77	67	54
Union Carbide	181	159	159	148	275	265	245	240	207	166	161
TOTAL	$3043	$2867	$2631	$2428	$2284	$2031	$1849	$1737	$1536	$1295	$1106
ANNUAL CHANGE	6%	9%	8%	6%	12%	10%	6%	13%	19%	17%	14%
PHARMACEUTICAL & DIVERSIFIED COMPANIES											
Allied-Signal[c]	$ 603	$ 647	$ 667	$ 734	$ 470	$ 389	$ 383	$ 177	$ 152	$ 105	$ 70
Du Pont	1387	1319	1223	1156	1144	1097	966	879	718	591	509
Eastman Kodak	1253	1147	992	1059	976	838	746	710	615	520	459
Eli Lilly	605	512	466	427	370	341	294	267	235	201	178
FMC	150	144	132	146	149	121	102	105	94	81	69
Merck & Co.	751	669	566	480	426	393	356	320	274	234	188
Morton International[c,d]	38	35	31	29	34	28	21	7	6	6	5
Pfizer	531	473	401	336	287	255	230	199	179	162	139
Upjohn	407	380	356	314	284	247	218	185	162	139	122
TOTAL	$5725	$5326	$4834	$4681	$4140	$3709	$3316	$2849	$2435	$2039	$1739
ANNUAL CHANGE	7%	10%	3%	13%	12%	12%	16%	17%	19%	17%	16%

Note: Prior years not restated to reflect company revisions. a For fiscal year ending Sept. 30. b Adjusted to reflect spin-off of Tredegar Industries. c Includes all company-financed R&D but excludes contract R&D. d Fiscal year ends June 30; data for Morton International prior to 1985. **Source:** Company data

INDUSTRY BALANCE SHEET: Stockholders' equity up 10% as liabilities hold steady

Industrial chemicals and synthetics

Assets	1989 ($ billions)	1988 ($ billions)	Change
Current assets			
Cash	$ 1.70	$ 2.16	−21%
Short-term securities	1.42	1.96	−27
Receivables	17.62	17.41	1
Inventories	14.66	14.59	1
Other current assets	3.97	4.71	−16
Total	**39.37**	**40.82**	**−4**
Fixed assets			
Depreciable fixed assets	**93.72**	**88.51**	**6**
Land and mineral rights	5.52	5.46	1
Less: accumulated depreciation and depletion	48.30	46.24	4
Net fixed assets	50.93	47.73	7
Other assets, including investments and intangibles	**37.60**	**34.42**	**9**
TOTAL ASSETS	**$127.91**	**$122.97**	**4%**

Liabilities and stockholders' equity	1989 ($ billions)	1988 ($ billions)	Change
Current liabilities			
Short-term debt	$ 4.88	$ 4.39	11%
Accounts payable	9.10	8.39	8
Accrued income taxes	1.29	1.71	−25
Current portion of long-term debt	1.93	1.77	9
Other current liabilities	10.60	12.05	−12
Total	**27.80**	**28.32**	**−2**
Long-term debt	**29.42**	**28.51**	**3**
Other liabilities, including deferred taxes and minority interest	**14.10**	**14.47**	**−3**
TOTAL LIABILITIES	**71.32**	**71.30**	**0**
Stockholders' equity			
Capital stock and other capital	17.78	18.05	−1
Retained earnings	38.81	33.62	15
TOTAL STOCKHOLDERS' EQUITY	**56.59**	**51.67**	**10**
TOTAL LIABILITIES AND STOCKHOLDERS' EQUITY	**$127.91**	**$122.97**	**4%**

Source: Bureau of the Census

DEBT RATIOS: Remain high compared with levels of early 1980s

$ Billions	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979
INDUSTRIAL CHEMICALS AND SYNTHETICS											
Long-term debt	$ 29.4	$ 28.5	$ 28.3	$ 20.8	$ 19.2	$ 18.1	$ 19.4	$ 22.0	$ 21.4	$ 16.8	$ 14.8
Stockholders' equity	$ 56.6	$ 51.7	$ 45.3	$ 41.6	$ 40.8	$ 46.5	$ 45.3	$ 45.9	$ 42.5	$ 39.8	$ 32.3
Debt ratio[a]	34.2%	35.6%	38.4%	33.4%	32.0%	28.0%	30.0%	32.4%	33.5%	29.6%	31.4%
CHEMICALS AND ALLIED PRODUCTS											
Long-term debt	$ 64.2	$ 58.9	$ 53.6	$ 46.8	$ 38.2	$ 33.8	$ 36.2	$ 38.2	$ 36.9	$ 28.3	$ 24.9
Stockholders' equity	$ 127.1	$120.5	$106.9	$100.8	$100.3	$100.3	$ 97.2	$ 95.3	$ 89.9	$ 79.5	$ 67.4
Debt ratio[a]	33.5%	32.8%	33.4%	31.7%	27.6%	25.2%	27.2%	28.6%	29.1%	26.3%	27.0%
ALL MANUFACTURING											
Long-term debt	$ 594.9	$535.4	$451.7	$407.5	$367.0	$324.2	$286.6	$293.1	$266.5	$236.2	$204.3
Stockholders' equity	$1006.3	$979.9	$912.8	$878.1	$870.7	$883.6	$837.6	$783.0	$762.3	$699.7	$624.0
Debt ratio[a]	37.2%	35.3%	33.1%	31.7%	29.6%	26.8%	25.5%	27.2%	25.9%	25.2%	24.7%

Note: Because of the changes in accounting rules and industry classifications, numbers over the entire range of years are not strictly comparable. a Long-term debt as a percentage of long-term debt plus stockholders' equity. **Source:** Bureau of Census

CASH FLOW: Chemical firms hiked borrowing and used working capital to meet cash needs last year

$ Millions, % of total	1989		1988		1987		1986		1985	
SOURCES OF FUNDS										
Net income	$ 7,621	29.2%	$ 7,698	39.2%	$ 5,749	29.8%	$ 3,395	13.4%	$ 658	4.3%
Depreciation and depletion	6,108	23.4	5,602	28.6	5,311	27.6	5,157	20.3	5,079	32.9
Deferred taxes	156	0.6	302	1.5	304	1.6	555	2.2	−37	−0.2
Other internal sources	3,355	12.8	2,164	11.0	4,257	22.1	6,378	25.1	7,109	46.1
Long-term debt	8,125	31.1	3,619	18.4	2,893	15.0	8,732	34.4	2,339	15.2
Stock	753	2.9	236	1.2	759	3.9	1,199	4.7	265	1.7
TOTAL	**$ 26,118**	**100.0%**	**$19,622**	**100.0%**	**$19,273**	**100.0%**	**$25,416**	**100.0%**	**$15,414**	**100.0%**
APPLICATIONS OF FUNDS										
Dividends	$ 2,602	10.0%	$ 2,308	11.8%	$ 2,196	11.4%	$ 1,994	7.8%	$ 2,050	13.3%
Capital expenditures	10,017	38.4	9,125	46.5	6,525	33.9	6,076	23.9	6,612	42.9
Additions to working capital	−1,714	−6.6	756	3.9	2,868	14.9	−437	−1.7	−47	−0.3
Reduction of long-term debt	5,529	21.2	3,107	15.8	2,649	13.7	7,801	30.7	2,672	17.3
Other applications	9,685	37.1	4,326	22.0	5,035	26.1	9,982	39.3	4,126	26.8
TOTAL	**$ 26,118**	**100.0%**	**$19,622**	**100.0%**	**$19,273**	**100.0%**	**$25,416**	**100.0%**	**$15,414**	**100.0%**

Note: Data are totals for 12 major chemical producers: American Cyanamid, Dow Chemical, Du Pont, Ethyl (excludes insurance business), B. F. Goodrich, W. R. Grace, Hercules, Monsanto, Olin, Quantum Chemical, Rohm & Haas, and Union Carbide. **Sources:** Company annual reports

2 Finances of the U.S. Chemical Industry

Last year was a good one for many leading chemical producers at the same time that it was distinctly mediocre for several others. The difference often reflected the type of products that a company turns out.

Firms with a product line focused on specialty chemicals frequently managed to push sales and earnings to record highs despite a slowing in the nation's economic growth overall. Great Lakes Chemical, for example, with a broad line of specialties based on bromine or furfural, upped its net income 19%, thanks in part to developing new market niches for its products. Loctite, finding new outlets for its adhesives, lifted profits 30%. Some of the chemical industry's highly diversified giants, such as Dow, Du Pont, and Monsanto, also did relatively well. For them, too, newly developed specialty products get much of the credit.

On the other hand, for producers who are tied closely to commodity petrochemicals or plastics and consequently are often less able to exert as much control over their competitive markets and vulnerable selling prices—among them Quantum Chemical, Sterling Chemicals, Borden Chemicals & Plastics, and B. F. Goodrich—profitability last year often was disappointing compared with 1988's robust results.

Explanation of table headings

Year. Data are for calendar year unless otherwise indicated.

Net sales. Gross sales, less discounts, allowances, and returns; generally excludes excise taxes and other operating income or revenues.

Net income. Net sales and other income, less operating costs, nonoperating charges, depreciation, depletion, interest expense, deferred charges, minority interest in income, and taxes. Nonrecurring or extraordinary credits and charges have been excluded in most cases, but these items are indicated by a footnote.

Total assets. Sum at year's end of current assets, investments, prepaid expenses, net plant and equipment, and other tangible assets. Excludes insofar as possible intangible assets including goodwill, value of patents and trademarks, and the like.

Current ratio. The ratio of current assets (cash, marketable securities, receivables, and inventories but excluding prepaid expenses) to total current liabilities.

Net plant and equipment. Value at year's end of fixed assets, less accumulated depreciation, amortization, and depletion.

Capital expenditures. Total spending during the year for new fixed assets, such as plant, equipment, and land, and for replacement and modernization of facilities.

Net worth. Equity at year's end of preferred and common stock holders, including value of capital stock, capital and earned surplus, and surplus reserves, as well as contingency and miscellaneous reserves for which no definite purpose is stated. Intangible assets are deducted insofar as possible.

Net income (breakdown). Percent of sales: net income divided by net sales. **Percent of net worth:** net income divided by tangible net worth. **Dollars per share:** net income, less preferred dividends, divided by the number of shares of common stock outstanding. All figures are adjusted for stock splits, but no adjustment has been made for earlier years as a result of stock dividends or for dilution that might result from the conversion of preferred stock or debt to common stock or the exercise of stock options outstanding.

Dividends per share. Cash dividends paid (or declared) on each share of common stock; excludes the value of stock dividends, which are indicated by a footnote.

Dividend yield. Dividends per share divided by the average of the high and low prices of the common stock during the calendar year.

Stock price range. High-low market prices of common stock during the calendar year, adjusted for stock splits but not for stock dividends.

Price-earnings ratio. Average of the high and low prices of the common stock during the calendar year divided by net income per share.

Year	Net sales	Net income	Total assets	Current ratio	Net plant and equipment	Capital expenditures	Net worth	NET INCOME % of sales	NET INCOME % of net worth	NET INCOME $ per share	Dividends, $ per share	Dividend yield, % of price	Stock price range, $ per share	Price-earnings ratio
	(Money figures in thousands of dollars unless otherwise indicated)													
CHEMICALS														
Air Products & Chemicals														
1989[a]	$2,641,823	$222,137	$3,313,343	1.3	$2,217,594	$413,735	$1,392,534	8.4%	16.0%	$4.04	$1.26	2.8%	$48¾–40	11.0
1988[a]	2,431,866	213,747	2,962,295	1.1	2,061,642	409,433	1,235,027	8.8	17.3	3.90	1.10	2.4	53⅜–36½	11.5
1987[a]	2,132,176	159,688[b]	2,695,625	1.2	1,920,520	322,765	1,140,512	7.5	14.0	2.83[b]	0.90	2.2	53⅞–29	14.6
1986	1,982,134	4,735[c]	2,700,151	1.4	1,829,122	366,563	1,094,562	0.2	0.4	0.08[c]	0.77	2.2	41⅝–29⅛	422.2
American Cyanamid Co.														
1989	$4,825,000	$292,000	$4,719,800	1.4	$1,757,000	$397,600	$2,070,000	6.1%	14.1%	$3.12	$1.31	2.5%	$60⅜–45⅝	17.0
1988	4,592,000	305,600	4,332,200	1.4	1,556,800	373,800	1,801,100	6.7	17.0	3.41	1.16	2.4	56–41⅞	14.4
1987	4,166,100	264,000[d]	3,878,400	1.5	1,391,900	268,100	1,622,400	6.3	16.3	2.89	1.025	2.4	57–29	14.9
1986	3,815,900	202,500	3,482,400	1.7	1,267,700	262,500	1,536,000	5.3	13.2	2.18	0.95	2.6	44⅞–27⅛	16.5
Arco Chemical Co.														
1989	$2,663,000	$405,000	$2,655,000	2.0	$1,263,000	$262,000	$1,591,000	15.5%	25.5%	$4.22	$2.125	6.1%	$40⅜–28¾	8.2
1988	2,700,000	494,000	2,548,000	1.8	1,078,000	199,000	1,375,000	18.3	35.9	5.00	0.85	2.8	38–23¼	6.1
1987[e]	1,952,000	257,000	2,534,000	1.3	984,000	295,000	1,116,000	13.2	23.0	2.58[f]	0.20	0.7	38¾–17	10.8
1986	1,541,000	143,000	1,450,000	2.6	752,000	167,000	952,000[f]	9.3	15.0	1.44[f]	—	—	—	—
Betz Laboratories														
1989	$ 516,669	$ 55,860	$ 358,743	2.4	$ 201,464	$ 52,952	$ 172,971	10.8%	32.3%	$3.53	$1.78	3.2%	$62⅜–47¼	15.5
1988	447,580	48,385	307,862	1.9	174,970	43,505	219,901	10.8	22.0	3.15	1.60	3.4	52½–41¼	14.9
1987	385,868	40,634	275,664	1.7	153,200	25,428	193,959	10.5	20.9	2.59	1.46	3.1	58¼–35	18.0
1986	344,377	35,544	267,681	2.3	144,053	22,750	202,104	10.3	17.6	2.23	1.36	3.4	44¾–35	17.9

a Fiscal year ends Sept. 30. b Excludes extraordinary net loss on extinguishment of debt of $4.1 million ($0.07 per share). c Includes special charge for writedown of assets, revaluation of South African investment, and staff reduction program of $132.2 million ($2.25 per share) and for loss of investment tax credits of $7 million ($0.13 per share). d From continuing operations; excludes net income from discontinued operations of $11.6 million ($0.13 per share) but includes gain on sale of fragrance and skin care business, before taxes, of $12.0 million ($0.13 per share). Arco Chemical, previously a subsidiary of Atlantic Richfield Co., became an independent, publicly owned company on Oct. 5, 1987. f Pro forma.

2 Finances of the U.S. Chemical Industry

Year	Net sales	Net income	Total assets	Current ratio	Net plant and equipment	Capital expenditures	Net worth	NET INCOME % of sales	NET INCOME % of net worth	NET INCOME $ per share	Dividends, $ per share	Dividend yield, % of price	Stock price range, $ per share	Price-earnings ratio
					(Money figures in thousands of dollars unless otherwise indicated)									
Borden Chemicals & Plastics Ltd. Partnership														
1989	$ 465,923	$ 69,495	$ 549,628	1.9	$ 417,186	$ 28,157	$ 341,707	14.9%	20.3%	$ 1.87[a]	$2.45[a]	14.4%	$ 24–10[a]	9.1
1988	552,975	121,014	604,822	1.7	429,280	18,877	363,271	21.9	33.3	3.26[a]	3.02[a]	19.5	20⅛–10⅞	4.8
1987[b]	35,894	4,781	560,319	1.7	449,258	3,485	354,534	13.3	—	0.13[a]	0.11[a]	1.0	12–9¾[a]	83.7
1986	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cabot Corp.														
1989[c]	$ 1,936,912	($6,509)[d,e]	$1,400,550	1.3	$ 743,179	$ 192,302	$ 472,333	—	—	($ 0.40)[d,e]	$1.01	2.6%	$45⅛–32⅞	—
1988[c]	1,676,588	61,175[c]	1,530,186	1.3	838,909	169,957	594,295	3.6%	10.3%	2.27[f]	0.92	3.2	41¾–29⅛	15.6
1987[c]	1,424,041	39,235[g]	1,447,001	1.2	794,470	81,087	574,610	2.8	6.8	1.42[g]	0.92	2.5	49¼–25¼	26.2
1986[c]	1,309,915	73,061[h]	1,490,759	2.0	642,137	72,551	572,145	5.6	12.8	2.56[h]	0.92	3.1	35⅜–23⅜	11.5
Chemed Corp.														
1989	$ 591,824	$26,182	$ 279,181	1.6	$ 65,814	$ 14,116	$ 64,634	4.4%	40.5%	$ 2.61	$1.84	5.2%	$38⅝–32½	13.6
1988	500,647	20,649[i]	268,496	1.7	61,102	14,641	57,061	4.1	36.2	2.23[i]	1.72	5.1	38–29¾	15.2
1987	391,004	20,362	220,549	1.5	48,545	8,893	69,944	5.2	29.1	2.28	1.60	4.5	44⅛–26⅜	15.5
1986	359,476	6,830[j]	229,316	1.6	46,554	9,385	75,339	1.9	9.1	0.76[j]	1.56	4.4	40–30⅛	46.1
Cromptor & Knowles Corp.														
1989	$ 355,817	$24,501	$ 189,952	1.6	$ 50,847	$ 13,407	$ 71,003	6.9%	34.5%	$ 2.00	$0.58	2.5%	$31½–14⅞	11.6
1988	289,787	16,845[k]	177,204	1.5	43,685	7,050	53,483	5.8	31.5	1.43[k]	0.43	3.1	17⅞–10	9.8
1987	237,469	11,750	127,689	2.2	29,085	3,632	68,265	4.9	17.2	0.98	0.335	2.8	15⅛–9	12.4
1986	213,242	8,923[l]	126,881	2.2	28,511	3,514	60,565	4.2	14.5	0.66[l]	0.315	4.0	9⅞–6⅛	12.0
Dexter Corp.														
1989	$ 848,724	$42,977	$ 611,277	2.2	$ 252,895	$ 33,119	$ 242,068	5.1%	17.8%	$ 1.73	$0.82	3.0%	$34¾–20⅛	15.9
1988	827,266	39,889[m]	540,960	2.2	186,894	26,145	221,795	4.8	18.0	1.61[m]	0.80	3.3	28¾–20⅛	15.2
1987	782,781	42,785	517,296	2.3	183,972	23,619	205,269	5.5	20.8	1.72	0.60	2.4	32⅜–17	14.4
1986	650,051	33,635	475,337	2.0	174,644	23,861	168,309	5.2	20.0	1.35	0.57	2.8	23⅜–16⅞	14.9
Dow Chemical Co.														
1989	$17,600,000	$2,487,000	$18,169,000	1.1	$ 7,642,000	$1,764,000	$ 3,960,000	14.1%	62.8%	$ 9.20	$2.18	3.4%	$72¼–55½	6.9
1988	16,682,000	2,410,000[n]	15,548,000	1.9	6,576,000	1,267,000	6,564,000	14.4	36.7	8.55[n]	1.63	2.9	62⅝–51⅛	6.7
1987	13,377,000	1,245,000[o]	13,871,000	1.7	5,551,000	995,000	5,284,000	9.3	23.6	4.33[o]	1.40	2.5	73–39⅛	13.0
1986	11,113,000	741,000[p]	11,939,000	1.6	5,347,000	890,000	4,865,000	6.7	15.2	2.58[p]	1.23	3.6	41⅛–26⅝	13.1
E. I. du Pont de Nemours & Co.														
1989	$35,534,000	$2,480,000	$33,829,000	1.2	$18,876,000	$4,285,000	$14,912,000	7.0%	16.6%	$ 3.53	$1.45	4.1%	$42⅛–28⅝	10.0
1988	32,917,000	2,190,000	30,159,000	1.5	17,221,000	4,001,000	15,020,000	6.7	14.6	3.04	1.23	4.4	30⅞–25¼	9.3
1987	30,468,000	1,786,000	27,604,000	1.5	15,854,000	3,035,000	13,639,000	5.9	13.1	2.46	1.10	3.2	43⅝–25	13.9
1986	27,148,000	1,538,000	26,083,000	1.5	15,697,000	2,737,000	12,724,000	5.7	12.1	2.12	1.02	4.0	30¾–19⅞	12.0
Ethyl Corp.														
1989	$1,519,637[q]	$219,468[r]	$ 5,507,009[s]	2.2	$ 579,760	$ 119,082	$ 776,785	14.4%	28.3%	$ 1.83[r]	$0.51	2.0%	$29–21⅛	13.7
1988	2,011,487[q]	231,016	5,107,817[s]	2.5	719,551	151,116	986,289	11.5	23.4	1.91	0.45	2.2	24⅛–17⅛	10.8
1987	1,720,338[q]	193,319	1,875,614	2.2	674,075	138,481	852,799	11.2	22.7	1.57	0.40	1.7	32⅛–15	15.0
1986	1,579,254[q]	177,734	1,667,825	2.1	594,238	133,700	895,790	11.3	19.8	1.40	0.335	1.8	22¾–13½	12.9
Ferro Corp.														
1989	$ 1,083,573	$49,748	$ 655,206	1.8	$ 220,022	$ 49,581	$ 283,144	4.6%	17.6%	$ 2.25	$0.60	1.9%	$40–22¼	13.8
1988	1,008,990	46,620	574,943	1.7	197,222	49,308	282,137	4.6	16.5	2.26	0.46	2.3	27⅛–14	9.1
1987	871,088	31,687	521,314	1.7	171,889	30,674	249,039	3.6	12.7	1.53	0.45	2.7	20⅞–11⅝	10.6
1986	725,241	24,082	443,801	1.9	153,712	23,162	217,750	3.3	11.1	1.18	0.40	3.4	13¾–10	10.1
First Mississippi Corp.														
1989[t]	$ 433,469	$16,511	$ 472,394	1.6	$ 280,008	$ 107,011	$ 187,145	3.8%	8.8%	$ 0.81	$0.285	1.7%	$20½–13⅛	20.8
1988[t]	318,086	32,475	325,339	1.5	166,966	60,381	181,447	10.2	17.9	1.61	0.24	1.6	18⅜–12	9.4
1987[t]	278,946	18,610	276,638	1.8	152,671	19,527	138,882	6.7	13.4	0.93	0.24	1.9	19⅛–6½	13.8
1986[t]	268,898	(28,110)[d]	287,562	1.6	155,266	31,635	125,521	—	—	(1.42)[d]	0.24	3.6	8⅛–5¼	—
Georgia Gulf Corp.														
1989	$ 1,104,468	$191,990	$ 448,476	2.2	$ 209,080	$ 54,159	$ 305,828	17.4%	62.8%	$ 7.58	$1.00	2.1%	$59⅞–36	6.3
1988	1,060,612	193,604	437,083	2.0	169,256	25,062	235,839	18.3	82.1	6.75	0.65	2.0	39⅞–24⅜	4.8
1987	707,453	91,736[u]	308,609	1.7	119,984	9,931	142,546	13.0	64.4	3.15[u]	0.20	0.9	34½–9⅞	7.1
1986	583,255	39,123	264,632	2.0	119,116	7,428	77,956	6.7	50.2	1.20	0.00	0.0	10–9¾	8.2

a Per partnership preference unit. b Borden Chemicals & Plastics, previously the basic chemicals and polyvinyl chloride operations of Borden Inc., commenced independent operations as a publicly owned limited partnership Nov. 30, 1987. c Fiscal year ends Sept. 30. d Net loss. e From continuing operations; includes pretax loss on restructuring of energy group of $71.7 million but excludes net gain from sale of discontinued operations of $24.6 million ($0.95 per share). f Excludes extraordinary net charge on early retirement of debt of $816,000 ($0.03 per share). g Excludes extraordinary net charge on early retirement of debt of $10.5 million ($0.38 per share). h Excludes extraordinary net charge on early retirement of debt of $2.0 million ($0.07 per share). i From continuing operations; excludes net income from discontinued operations, extraordinary net gain on termination of pension plan, and cumulative effect of changes in accounting principles of $3.5 million ($0.37 per share). j From continuing operations; excludes net income and net gain on sale of discontinued Vestal Laboratories operations of $30.0 million ($3.36 per share) and extraordinary net gain on termination of pension plan of $811,000 ($0.09 per share). k From continuing operations; excludes net loss from operations and disposal of maintenance chemicals business of $1.5 million ($0.12 per share). l From continuing operations; excludes net income and net charge for discontinued Kem operations of $7.9 million ($0.62 per share). m From continuing oeprations; excludes net loss from discontinued operations of $4.4 million ($0.18 per share). n Excludes net loss on early extinguishment of debt of $12 million ($0.04 per share). o Excludes net loss on early extinguishment of debt of $5 million ($0.02 per share). p Excludes net loss on early extinguishment of debt of $9 million ($0.03 per share). q Excludes insurance revenues. r From continuing operations; excludes income from spun-off aluminum, plastics, and energy businesses of $11.9 million ($0.10 per share). s Includes total assets of insurance business, previously carried as net investment in the business. t Fiscal year ends June 30. u Excludes net charge on retirement of debt of $9.9 million ($0.34 per share).

Year	Net sales	Net income	Total assets	Current ratio	Net plant and equipment	Capital expenditures	Net worth	NET INCOME % of sales	NET INCOME % of net worth	NET INCOME $ per share	Dividends, $ per share	Dividend yield, % of price	Stock price range, $ per share	Price-earnings ratio
					(Money figures in thousands of dollars unless otherwise indicated)									
B. F. Goodrich Co.														
1989	$2,419,700	$171,200[a]	$2,102,900	2.0	$ 991,500	$240,400	$1,117,000	7.1%	15.3%	$ 6.23[a]	$2.00	3.7%	$69–38½	8.6
1988	2,416,700	209,900[b]	1,987,300	1.9	934,400	180,500	1,080,200	8.7	19.4	7.99[b]	1.72	3.5	60¾–37½	6.1
1987	2,168,000	83,900[c]	1,905,800	1.4	898,200	142,600	972,600	3.9	8.6	3.17[c]	1.56	3.4	65–27¾	14.6
1986	2,553,300	12,900[d]	1,786,700	1.4	865,200	144,000	799,200	0.5	1.6	0.46[d]	1.56	3.9	47⅞–32⅛	87.0
W. R. Grace & Co.														
1989	$6,114,600	$256,600[e]	$5,321,300	1.3	$2,220,000	$484,600	$1,432,600	4.2%	17.9%	$ 3.01[e]	$1.40	4.4%	$39⅛–25⅛	10.7
1988	5,786,100	192,000[f]	5,095,200	1.3	2,028,300	418,100	1,336,000	3.3	14.4	2.26[f]	1.40	5.2	29⅞–23½	11.8
1987	4,515,400	141,900[g]	4,361,500	1.4	1,701,000	242,500	1,351,200	3.1	10.5	1.67[g]	1.40	5.0	37⅜–19⅛	16.9
1986	3,725,700	(375,400)[h,i]	3,993,000	1.5	1,579,000	199,100	1,204,400	—	—	(4.47)[h,i]	1.40	5.3	30⅜–22⅝	—
Great Lakes Chemical Corp.														
1989	$ 792,327	$122,918	$ 934,802	2.0	$ 275,864	$ 40,466	$ 428,263	15.5%	28.7%	$ 3.52	$0.38	1.0%	$48–28⅛	10.8
1988	557,770	103,288	612,242	1.7	234,405	47,017	430,629	18.5	24.0	2.97	0.34	1.2	33–24¼	9.7
1987	478,386	55,536	523,365	1.8	218,403	35,186	338,880	11.6	16.4	1.67	0.30	1.1	38½–18	16.9
1986	300,329	26,817	447,840	2.3	209,425	18,327	172,538	8.9	15.5	0.89	0.26	1.4	22¼–15½	21.1
Hercules														
1989	$3,091,669	($96,359)[h,j]	$3,653,163	1.7	$1,416,475	$292,554	$1,897,206	—	—	($ 2.09)[h,j]	$2.24	4.9%	$52¼–38⅜	—
1988	2,802,072	120,435	3,325,294	2.8	1,164,102	251,043	2,044,533	4.3%	5.9%	2.55	2.00	4.1	54–42⅝	18.9
1987	2,693,003	208,000[k]	3,492,077	3.6	1,075,389	205,037	2,189,867	7.7	9.5	4.02[k]	1.84	3.2	73½–40	14.1
1986	2,615,110	206,200[l]	2,914,319	2.6	1,152,141	256,913	1,703,151	7.8	12.1	3.66[l]	1.72	3.5	60–37	13.3
IMC Fertilizer Group														
1989[m]	$1,221,700	$137,300	$1,677,900	1.4	$1,144,100	$ 55,300	$ 765,300	11.2%	17.9%	$ 5.27	$1.02	2.5%	$49¾–31¼	7.7
1988[m,n]	1,085,600	111,700	1,472,100	1.6	780,000	26,300	676,100	10.3	16.5	3.88	0.37	1.1	45⅛–22½	8.7
1987[m]	876,200	26,600	1,332,200	1.7	841,600	110,400	1,004,300	3.0	2.6	0.10	—	—	—	—
1986[m]	866,000	(34,700)[h]	1,242,500	2.2	—	52,000	1,028,800	—	—	—	—	—	—	—
International Flavors & Fragrances														
1989	$ 869,519	$138,565	$ 969,649	5.1	$ 236,505	$ 34,178	$ 764,913	15.9%	18.1%	$ 3.65	$1.92	3.0%	$77½–48½	17.3
1988	839,545	128,684	882,333	5.0	228,152	40,812	695,433	15.3	18.5	3.40	1.60	3.3	54½–43⅛	14.4
1987	745,861	107,017	874,554	4.2	219,305	36,946	659,908	14.3	16.2	2.83	1.24	2.6	57¾–37¼	16.8
1986	620,679	85,683	672,616	4.6	186,891	26,771	521,475	13.8	16.4	2.29	1.16	2.8	48⅞–34½	18.2
International Minerals & Chemical Corp.														
1989[m]	$ 982,900	$110,300[o]	$1,753,000	3.2	$ 480,200	$ 82,200	$ 669,600	11.2%	16.5%	$ 4.20[o]	$1.00	2.1%	$55½–38	11.1
1988[m]	1,470,600	103,900[p]	1,588,900	2.0	445,800	81,200	822,800	7.1	12.6	3.30[p]	1.00	2.3	51½–37¼	13.4
1987[m]	1,637,500	14,600[q]	2,242,400	1.4	2,292,500	62,500	877,200	0.9	1.7	0.08[q]	1.00	2.5	53–26½	496.9
1986[m]	1,177,700	(79,600)[h,r]	2,225,200	2.2	2,170,700	93,900	792,400	—	—	(2.96)[h,r]	1.80	5.9	36¼–25	—
Lawter International														
1989	$ 136,006	$19,468	$ 133,988	3.9	$ 24,412	$ 3,073	$ 87,752	14.3%	22.2%	$ 0.81	$0.52	4.1%	$13⅞–11⅜	15.6
1988	125,818	20,851	125,210	3.7	24,546	4,524	79,521	16.6	26.2	0.88	0.52	4.2	14⅛–10¾	14.1
1987	112,018	16,701	109,917	4.3	22,603	1,528	69,458	14.9	24.0	0.71	0.42	3.5	15⅝–8½	17.0
1986	103,515	12,945	93,392	3.7	22,447	1,613	55,191	12.5	23.5	0.56	0.42	3.9	13–8⅝	19.5
Loctite Corp.														
1989[m]	$ 456,498	$54,476	$ 344,206	2.8	$ 70,143	$ 15,983	$ 211,805	11.9%	25.7%	$ 3.03	$0.90	2.1%	$51–32¾	13.8
1988[m]	416,880	41,850	328,833	2.4	73,008	14,466	187,100	10.0	22.4	2.32	0.61	1.8	39–27	14.2
1987[m]	337,802	30,655	289,367	1.9	70,802	15,470	167,561	9.1	18.3	1.69	0.47	1.7	36–19	16.3
1986[m]	266,788	23,173	240,665	2.2	57,711	9,299	150,163	8.7	15.4	1.28	0.41	2.0	24⅞–16⅝	16.2
Lubrizol Corp.														
1989	$1,220,386	$93,980	$ 960,184	2.9	$ 316,493	$ 64,721	$ 663,264	7.7%	14.2%	$ 2.52	$1.38	3.5%	$45⅛–34⅛	15.7
1988	1,117,493	131,206[s]	970,671	3.0	298,670	54,611	664,308	11.7	19.8	3.40[s]	1.30	3.6	42⅜–30	10.6
1987	1,013,430	81,335	939,378	3.0	297,573	42,040	621,633	8.0	13.1	2.06	1.22	3.6	41¾–25¼	16.3
1986	976,776	78,185	877,907	2.7	289,078	40,460	572,679	8.0	13.7	1.97	1.17	3.9	35⅛–25⅝	15.4
Monsanto Co.														
1989	$8,681,000	$679,000	$6,922,000	1.4	$3,173,000	$607,000	$2,259,000	7.8%	30.1%	$ 5.02	$1.65	3.2%	$62⅛–40¼	10.2
1988	8,293,000	591,000	6,671,100	1.3	3,146,000	590,000	2,010,000	7.1	29.4	4.14	1.475	3.6	46⅛–36¾	10.0
1987	7,639,000	436,000	6,502,000	1.4	3,076,000	505,000	1,948,000	5.7	22.4	2.82	1.375	3.5	50⅛–28½	14.0
1986	6,879,000	433,000	6,125,000	1.4	2,913,000	520,000	1,637,000	6.3	26.5	2.78	1.29	4.1	40¾–22⅜	11.4
Morton International														
1989[m]	$1,406,600	$122,100[t]	$1,169,600	1.7	$ 553,400	$131,900	$ 706,000	8.7%	17.3%	$ 2.55[t]	—	—	$41⅞–31½	14.4
1988[m,u]	2,316,400	159,400[v]	1,670,800	1.8	760,300	163,000	815,900	6.9	19.5	3.33[v]	$0.82	2.0%	46–35⅝	12.3
1987[m,u]	1,987,300	138,000	1,426,400	1.5	655,900	130,400	700,400	6.9	19.7	2.90	0.745	1.7	54¾–31	14.8
1986[m,u]	1,949,900	132,900	1,225,000	1.7	593,900	95,700	629,900	6.8	21.1	2.80	0.685	1.9	42½–30	12.9

a From continuing operations; excludes net income from discontinued operations of $1.2 million ($0.04 per share). b From continuing operations; excludes net loss from discontinued operations of $16.9 million ($0.68 per share) and net gain from cumulative effect of change in accounting for income taxes of $2.7 million ($0.11 per share). c From continuing operations; excludes net loss from discontinued operations of $4.7 million ($0.20 per share) and extraordinary net income of $25.8 million ($1.09 per share). d Excludes extraordinary net income of $19.8 million ($0.86 per share). e From continuing operations; excludes net loss from discontinued operations of $3.4 million ($0.04 per share). f From continuing operations; excludes net income from discontinued operations and net gain from cumulative effect of accounting change of $41.6 million ($0.49 per share). g From continuing operations; excludes net income from discontinued operations of $18.6 million ($0.22 per share) and tax benefit of operating loss carry-forward of $12.6 million ($0.14 per share). h Net loss. i From continuing operations; includes asset write-downs and reserves, before taxes, of $368.8 million but excludes net loss from discontinued operations of $96.9 million ($1.15 per share). j Excludes net gain from cumulative effect of accounting changes of $15.0 million ($0.33 per share). k Excludes net gain on disposal of Himont and other net gains and charges of $613.7 million ($10.72 per share). l Excludes nonrecurring net gains from sale of investments and businesses and nonrecurring net costs of $20.5 million ($0.36 per share). m Fiscal year ends June 30. n IMC Fertilizer Group, previously the fertilizer business group of International Minerals & Chemical Corp., became an independent, privately owned company on Feb. 2, 1988. o From continuing operations; excludes net gain from discontinued operations of $6.7 million ($0.29 per share). p From continuing operations; excludes net loss on disposal of discontinued operations of $5.0 million ($0.19 per share) and extraordinary credit of $16.2 million ($0.55 per share). q From continuing operations; excludes net income on disposal of discontinued operations of $11.3 million ($0.41 per share) and extraordinary net charge of $4.8 million ($0.18 per share). r From continuing operations; excludes net loss from and provision for loss on disposal of discontinued gas and oil and industrial products operations of $137.4 million ($5.08 per share). s Includes credit for patent litigation settlement, before taxes, of $81.2 million but excludes net credit for cumulative effect of change in accounting for income taxes of $8.8 million ($0.22 per share). t Excludes extraordinary net charges related to separation of Morton Thiokol's aerospace business in June 1989 and to other matters of $25.0 million ($0.52 per share). u Data for Morton Thiokol. v Excludes net charge for cumulative effect of change in accounting for income taxes of $14.1 million ($0.29 per share).

2 Finances of the U.S. Chemical Industry

Year	Net sales	Net income	Total assets	Current ratio	Net plant and equipment	Capital expenditures	Net worth	NET INCOME % of sales	NET INCOME % of net worth	NET INCOME $ per share	Dividends, $ per share	Dividend yield, % of price	Stock price range, $ per share	Price-earnings ratio
					(Money figures in thousands of dollars unless otherwise indicated)									
NL Industries														
1989	$1,000,883	$170,274[a]	$1,512,315	0.9	$ 380,465	$ 83,386	$ 137,310	17.0%	124.0%	$ 2.57[a]	$0.60	2.6%	$28–18¾	9.1
1988[b]	1,007,036	134,236[c]	836,941	1.4	344,020	70,624	150,951	13.3	88.9	2.02[c]	0.20[d]	3.1	7¾–5¼[d]	—
1987[b]	859,267	87,866[e]	1,092,483	1.5	315,907	73,318	406,220	10.2	21.6	1.31[e]	0.20[d]	2.6	11–4¼[d]	—
1986	549,314	(382,197)[f,g]	1,149,950	1.1	349,854	24,499	444,901	—	—	(6.31)[f,g]	0.17	1.7	16⅛–3⅜	—
Nalco Chemical Co.														
1989	$1,070,754	$119,909	$ 892,006	2.2	$ 350,886	$ 86,435	$ 397,207	11.2%	30.2%	$ 3.01	$1.36	3.2%	$49⅞–34½	14.3
1988	994,150	105,971	794,899	2.0	311,200	61,578	433,550	10.7	24.4	2.70	1.29	3.6	39⅞–31¼	13.2
1987	841,876	80,254	696,360	1.7	304,084	57,232	396,297	9.5	20.3	2.03	1.20	3.5	45½–24	17.1
1986	736,074	63,672	536,916	1.7	280,195	63,636	358,023	8.7	17.8	1.62	1.20	4.4	31¼–23½	16.9
Olin Corp.														
1989	$2,509,000	$124,000	$1,794,000	1.3	$ 781,000	$142,000	$ 555,000	4.9%	22.3%	$ 6.02	$1.95	3.3%	$68¼–49⅜	10.2
1988	2,308,000	98,000	1,799,000	1.3	801,000	147,000	542,000	4.2	18.1	4.63	1.70	3.4	60–40	10.8
1987	1,930,000	78,000	1,583,000	1.7	727,000	115,000	598,000	4.0	13.0	3.38	1.60	3.6	56¼–32⅝	13.1
1986	1,707,261	75,226	1,464,830	1.5	719,686	127,935	574,290	4.4	13.1	3.36	1.525	3.5	53¼–34⅝	13.1
Quantum Chemical Corp.														
1989	$2,671,000	$114,100[h]	$2,910,000	1.5	$1,759,300	$583,300	$(271,300)[i]	4.3%	—	$ 4.54[h]	$2.25[j]	3.3%	$107⅛–28½	14.9
1988	2,921,900	360,100[k]	2,881,300	0.7	1,308,600	333,500	(433,400)[i]	12.3	—	13.71[k]	2.40[j]	2.8	108¼–65½	6.3
1987	2,566,800	143,600[m]	2,519,300	1.3	1,380,200	154,200	983,500	5.6	14.6%	4.38[m]	2.20	3.4	88–42½	14.9
1986	1,729,600	55,100[n]	2,844,200	1.0	1,393,800	101,600	944,500	3.2	5.8	1.54[n]	2.20	5.7	47⅝–30	25.3
Rohm & Haas Co.														
1989	$2,661,000	$176,000[o]	$2,361,000	1.6	$1,148,000	$385,000	$1,217,000	6.6%	14.5%	$ 2.65	$1.16	3.4%	$37½–31	12.9
1988	2,535,000	230,000	2,148,000	1.7	935,000	338,000	1,113,000	9.1	20.7	3.46	1.02	3.1	37½–28	9.5
1987	2,203,000	195,000[p]	1,882,000	1.9	730,000	222,000	981,000	8.9	19.9	2.85[p]	0.86	2.2	53¼–24	13.6
1986	2,067,000	138,000[q]	1,756,000	2.0	648,000	179,000	916,000	6.7	15.1	2.01[q]	0.78	2.5	38¾–23¼	15.6
Sigma-Aldrich Corp.														
1989	$ 441,099	$63,958	$ 472,424	2.7	$ 176,431	$ 51,703	$ 298,851	14.5%	21.4%	$ 2.59	$0.37	0.7%	$59½–43¾	19.9
1988	375,282	56,477	359,671	2.5	119,518	35,605	243,906	15.0	23.2	2.29	0.33	0.7	51¼–39¾	19.9
1987	304,858	41,889	285,343	2.9	96,975	20,616	196,012	13.7	21.4	1.70	0.29	0.7	50⅝–30¼	23.8
1986	253,097	33,958	244,875	2.5	86,111	35,461	155,689	13.4	21.8	1.38	0.25	0.7	40¼–26¾	24.3
Stepan Co.														
1989	$ 346,350	$7,840	$ 215,351	1.7	$ 122,509	$ 34,090	$ 70,741	2.3%	11.1%	$ 1.42	$0.53	2.2%	$29½–17¾	16.6
1988	333,033	13,428	185,601	1.6	104,697	20,442	66,790	4.0	20.1	2.39	0.475	2.1	25⅝–19¾	9.5
1987	288,935	10,959	172,726	1.6	98,994	25,705	59,936	3.8	18.3	1.83	0.415	2.0	26¾–14½	11.2
1986	259,787	7,513	152,794	1.5	85,607	14,322	55,029	2.9	13.6	1.265	0.37	2.6	17⅝–10¾	11.3
Sterling Chemicals														
1989[r]	$ 580,797	$103,898	$ 329,040	1.3	$ 216,355	$ 57,592	$ 110,372	17.9%	94.1%	$ 1.77	$0.75	5.9%	$18¾–6⅞	7.2
1988[r]	698,964	213,845[s]	294,242	1.4	172,881	16,993	90,562	30.6	236.1	3.56[s]	3.17	—	17¾–14⅛	4.5
1987[r]	413,192	51,385[t]	283,375	1.2	169,119	13,174	60,184	12.4	85.4	0.86[t]	—	—	—	—
1986[u]	35,399	1,509	238,567	—	—	938	12,719	4.3	—	0.03	—	—	—	—
Union Carbide Corp.														
1989	$8,744,000	$573,000	$8,483,000	1.1	$4,584,000	$785,000	$2,320,000	6.6%	24.7%	$ 4.07	$1.00	3.6%	$33¼–22¾	6.9
1988	8,324,000	662,000	8,389,000	1.1	4,416,000	671,000	1,784,000	8.0	37.1	4.88	1.15	5.1	28⅜–17	4.6
1987	6,914,000	232,000	7,820,000	1.3	4,344,000	502,000	1,175,000	3.4	19.7	1.76	1.50	6.2	32½–15½	13.6
1986	6,244,000	130,000[v]	7,496,000	1.2	4,379,000	524,000	930,000	2.1	14.0	1.25[v]	1.50	5.8	33⅛–18¾	20.8
Vista Chemical Corp.														
1989[r]	$ 778,902	$119,902[w]	$ 550,594	1.4	$ 341,109	$ 99,011	$ (172,619)[i]	15.4%	—	$ 8.56[w]	$1.80	3.9%	$56¾–36⅛	5.4
1988[r]	781,351	123,917[x]	500,643	1.6	275,544	48,082	119,438	15.9	103.8%	7.10[x]	0.35	0.1	61–39	7.0
1987[r]	608,887	(1,762)[f,y]	474,265	1.5	266,250	20,889	134,686	—	—	(0.13)[f,y]	0.05	0.1	55⅛–18⅝	—
1986[r]	550,097	30,212[z]	453,418	1.8	272,699	15,792	60,808	5.5	49.7	1.73[z]	0.00	0.0	18¾–17	10.3

a Excludes extraordinary net gain of $2.6 million ($0.04 per share). b Restated to reflect restructuring and spin-off of petroleum services business on Dec. 22, 1988 (except as noted). c From continuing operations; excludes net income from discontinued operations of $21.5 million ($0.32 per share). d Before restructuring. e From continuing operations; excludes net loss from discontinued operations of $107.8 million ($1.64 per share). f Net loss. g From continuing operations; excludes net income from discontinued operations of $58.0 million ($0.51 per share). h From continuing operations; excludes net income and net gain on sale of oleochemical business of $133.3 million ($5.31 per share). i Deficit. j Plus 1% stock dividend. k From continuing operations; excludes net income from discontinued oleochemical business of $22.6 million ($0.86 per share). l Excludes special dividend declared of $50 per share. m From continuing operations; excludes net income from discontinued spirits and wine operations of $108.0 million ($3.37 per share). n From continuing operations; excludes net income from discontinued spirits and wine operations of $20.5 million ($0.67 per share). o Includes net gain on sale of interest in U.K. subsidiary of $15 million ($0.23 per share) and net loss on write-off of assets of $13 million ($0.20 per share). p Includes net gain on sale of assets of $5.0 million ($0.07 per share). q Includes net loss of disposal of assets of $9.2 million ($0.13 per share). r Fiscal year ends Sept. 30. s Excludes net loss on early extinguishment of debt of $9.0 million ($0.15 per share) and net gain on cumulative effect of change in accounting for income taxes of $8.3 million ($0.14 per share). t Excludes net loss on early extinguishment of debt of $4.0 million ($0.07 per share). u For two months ended Sept. 30. v From continuing operations of $569 million ($5.49 per share) and net charges for extraordinary items of $203 million ($1.96 per share). w Includes net gain associated with change in stock option plan of $586,000. x Includes net gain associated with change in stock option plan of $1.5 million but excludes net loss on extinguishment of debt of $10.8 million ($0.62 per share). y Includes net charge associated with change in stock option plan of $55.4 million and net gain on sale of interest in Petroquimica Argentina of $5.1 million but excludes net loss on extinguishment of debt of $1.9 million ($0.12 per share). z Excludes net loss on extinguishment of debt of $1.4 million ($0.08 per share).

Year	Net sales	Net income	Total assets	Current ratio	Net plant and equipment	Capital expenditures	Net worth	NET INCOME % of sales	NET INCOME % of net worth	NET INCOME $ per share	Dividends, $ per share	Dividend yield, % of price	Stock price range, $ per share	Price-earnings ratio
					(Money figures in thousands of dollars unless otherwise indicated)									
Witco Corp.														
1989	$1,587,788	$35,009	$1,121,358	3.4	$ 417,175	$70,387	$ 553,664	2.2%	6.3%	$1.60	$1.61	4.0%	$45¼–34⅝	24.9
1988	1,585,856	71,621[a]	1,096,219	3.1	400,996	72,059	559,985	4.5	12.8	3.05[a]	1.39	4.0	38⅜–30⅝	11.3
1987	1,427,650	63,293	1,037,624	3.0	374,628	69,082	494,941	4.4	12.8	2.72	1.16	3.1	47⅜–26⅝	13.6
1986	1,355,018	65,215	804,086	2.4	367,789	60,102	449,783	4.8	14.5	2.93	1.05	3.2	40–26⅜	11.3
PHARMACEUTICALS														
Abbott Laboratories														
1989	$5,379,751	$859,832	$ 4,851,635	1.2	$2,090,166	$573,138	$2,726,413	16.0%	31.5%	$1.92	$0.70	2.4%	$35⅛–23⅛	15.1
1988	4,936,991	752,027	4,825,113	1.4	1,952,622	521,196	2,464,649	15.2	30.5	1.66	0.60	2.5	26⅛–21⅜	14.3
1987	4,387,876	632,559	4,385,737	1.3	1,741,557	432,736	2,093,453	14.4	30.2	1.39	0.50	1.9	33½–20	19.3
1986	3,807,634	540,460	3,865,609	1.3	1,543,267	383,389	1,778,921	14.2	30.4	1.16	0.42	1.9	27½–15¾	18.7
American Home Products Corp.														
1989	$6,747,016	$1,102,158	$ 5,114,491	3.0	$1,481,686	$250,737	$1,403,027	16.3%	78.6%	$3.53	$1.95	4.1%	$54½–40⅛	13.4
1988	5,500,533	932,184	3,967,479	2.8	1,309,314	344,464	2,332,475	16.9	40.0	3.19	1.80	4.6	42⅛–35½	12.2
1987	5,028,272	845,081	3,956,855	2.0	1,153,028	216,525	1,878,178	16.8	45.0	2.86	1.67	4.2	48⅜–31	13.9
1986	4,926,512	778,824[b]	3,819,146	2.7	929,400	204,764	2,024,869	15.8	38.5	2.59[b]	1.55	4.0	47⅜–30⅝	15.1
Bristol-Myers Squibb Co.														
1989	$9,189,000	$ 747,000[c]	$ 8,273,00	1.9	$2,350,000	$562,000	$4,860,000	8.1%	15.4%	$1.43[c]	$2.00	3.9%	$58–44	35.7
1988[d]	5,972,500	829,000	4,988,500	2.9	1,249,100	252,300	3,345,800	13.9	24.8	2.88	1.68	4.0	46½–38⅛	14.7
1987[d]	5,401,200	709,600[e]	4,549,400	2.8	1,141,900	190,000	3,046,700	13.1	23.3	2.47[e]	1.40	3.3	55¾–28¼	17.0
1986[d]	4,835,900	589,500	3,993,900	2.5	1,070,000	221,900	2,646,500	12.2	22.3	2.07	1.06	2.9	44¼–30⅛	18.0
Eli Lilly & Co.														
1989	$4,175,600	$939,500	$ 5,394,400	1.6	$2,114,600	$554,500	$3,303,500	22.5%	28.4%	$3.20	$1.35	2.4%	$68½–42⅜	17.3
1988	4,069,700	761,000	4,852,800	1.7	1,806,600	372,100	2,815,400	18.7	27.0	2.67	1.15	2.8	45¾–35½	15.3
1987	3,643,800	410,500[f]	4,859,200	1.8	1,642,500	344,100	2,646,900	11.3	15.5	1.41[f]	1.00	2.4	53⅝–28⅞	29.2
1986	3,720,400	558,200	4,117,000	1.7	1,527,600	283,000	2,260,800	15.0	24.7	2.00	0.90	2.7	41¾–25¼	16.7
Merck & Co.														
1989	$6,550,500	$1,495,400	$ 6,593,400	1.7	$2,292,500	$433,000	$3,357,300	22.8%	44.5%	$3.78	$1.64	2.4%	$80¾–56¼	
1988	5,939,500	1,206,800	5,992,100	1.7	2,070,700	372,700	2,720,400	20.3	44.4	3.05	1.28	2.4	59⅝–48	17.6
1987	5,061,300	906,400	5,533,200	1.3	1,948,000	253,700	1,969,900	17.9	46.0	2.23	0.82	1.4	74¼–40⅝	25.8
1986	4,128,900	675,700	4,967,900	1.7	1,906,200	210,600	2,431,800	16.4	27.8	1.62	0.63	1.9	43⅛–22⅜	20.3
Pfizer														
1989	$5,671,500	$681,100	$ 7,894,800	1.4	$1,784,100	$456,500	$4,105,800	12.0%	16.6%	$4.04	$2.20	3.4%	$75¾–54	16.1
1988	5,385,400	791,300	7,218,200	1.7	1,655,100	343,700	3,881,700	14.7	20.4	4.70	2.00	3.7	60¼–47⅜	11.4
1987	4,919,800	690,200	6,684,700	2.0	1,505,900	258,300	3,644,500	14.0	18.9	4.08	1.80	3.1	77–40	14.3
1986	4,476,000	660,000	4,946,700	1.9	1,351,300	196,100	3,198,200	14.7	20.6	3.90	1.64	2.8	72⅞–46¼	15.3
Schering-Plough Corp.														
1989	$3,157,900	$471,300	$ 3,440,000	1.5	$1,210,700	$186,100	$1,781,900	14.9%	26.4%	$2.09	$0.875	2.5%	$43–27⅝	16.9
1988	2,969,400	389,900	3,234,500	1.2	1,181,000	156,100	1,485,900	13.1	26.2	1.74	0.70	2.7	29⅝–22⅝	15.0
1987	2,699,300	320,700[g]	3,053,200	1.2	1,131,100	118,000	1,317,300	11.9	24.3	1.38[g]	0.51	2.4	27⅝–15⅝	15.6
1986	2,398,700	265,800	2,862,200	1.3	1,143,500	124,800	1,319,700	11.1	20.1	1.08	0.45	2.5	22–14	16.6
Upjohn Co.														
1989	$2,907,332	$310,974[h]	$ 3,246,891	1.5	$1,283,437	$242,260	$1,736,125	10.7%	17.9%	$1.67[h]	$0.94	2.7%	$42⅛–27⅝	20.9
1988	2,746,248	353,418	3,139,328	1.6	1,239,598	240,997	1,820,952	12.9	19.4	1.90	0.80	2.6	35¼–26⅞	16.3
1987	2,521,024	305,039	3,043,131	1.9	1,114,391	211,976	1,673,512	12.1	18.2	1.63	0.63	1.6	53¾–23¼	23.6
1986	2,280,325	252,646	2,664,956	1.9	981,549	201,920	1,470,216	11.1	17.2	1.35	0.51	1.8	35½–20½	20.7
Warner-Lambert Co.														
1989	$4,195,800	$412,700	$ 2,719,700	1.1	$1,132,500	$218,500	$ 989,700	9.8%	41.7%	$3.05	$1.28	2.6%	$59⅜–37¼	15.8
1988	3,908,400	340,300	2,554,100	1.1	1,053,000	189,600	849,900	8.7	40.0	2.50	1.08	3.1	39¾–30	13.9
1987	3,484,700	295,800	2,396,500	1.1	959,800	176,900	795,000	8.5	37.2	2.08	0.885	2.6	43¾–24⅛	16.4
1986	3,102,918	261,784[i]	2,479,054	1.4	819,291	137,996	870,453	8.4	30.1	1.77[i]	0.795	2.9	31½–22½	15.3

a Excludes net gain on cumulative effect of accounting change of $20.3 million ($0.81 per share). b Includes gain on sale of Brach confectionary business and Household Research subsidiary, before taxes, of $535 million. c Includes charges and expenses for integrating operations of Bristol-Myers Co. and Squibb Corp., after taxes, of $693 million ($1.32 per share). d For Bristol-Myers Co. e Includes gain on sale of orthodontic and animal health businesses, before taxes, of $80.3 million. f From continuing operations; includes restructuring charges, before taxes, of $271.9 million but excludes net income and net gain on sale of discontinued cosmetics business of $233.2 million ($0.79 per share). g Excludes nonrecurring net charge of $4.3 million ($0.02 per share). h From continuing operations; includes restructuring and other nonrecurring charges of $57.3 million but excludes net loss on disposal of discontinued operations of $130.0 million ($0.72 per share). I Excludes net nonrecurring credit from write-down and divestiture of assets and restructuring program of $47.7 million ($0.32 per share).

3 Employment in the U.S. Chemical Industry

Chemical work force tops 1.1 million

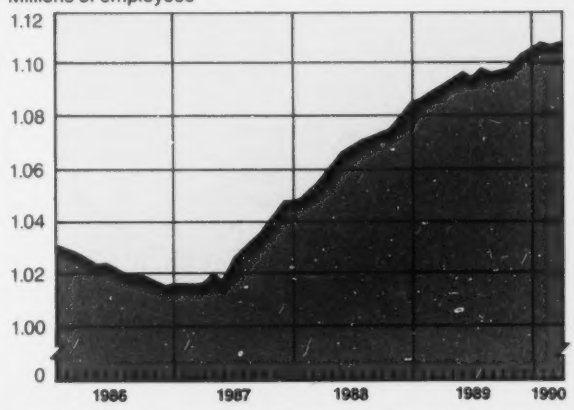
The number of people employed in the U.S. chemical industry has been rising steadily for the past three years, reaching more than 1.1 million by the end of 1989. Only once before—from 1979 to 1981—have so many people worked in the U.S. chemical industry. Production workers, too, of whom 619,000 were employed in the chemical industry at the end of 1989, are now at close to their historically high level of about 630,000 set a decade ago.

Although the past three years have seen employment grow in nearly all sectors of the chemical industry, for the decade as a whole a considerable shift has taken place in the areas where people work. When the 1980s began, two of every 10 chemical industry employees were involved in manufacturing plastics and synthetic materials, followed closely by drugs, and then by organic and inorganic chemicals. By 1989, drugs were the largest employment sector, with 22% of chemical industry employees working there. Plastics manufacture now claims 17% of the industry's work force, followed by soap and toiletries, which employs 14%.

Wages in the chemical industry rose, on average, 3% last year, keeping pace with manufacturing wages generally. The organic and inorganic chemicals sectors continue to pay the highest wages. Soap and paint makers, on average, pay the lowest, although even in these sectors, chemical workers earn about 10% more, on average, than workers in all other manufacturing jobs.

Women comprise a slightly smaller fraction of chemical workers than they do for all manufacturing—29% for the chemical industry in 1988 compared with 33% for manufacturing industries as a whole. But their numbers are increasing faster—up from 24% a decade earlier, when women held 30% of all manufacturing jobs. Some fields, particularly the drug and toiletries industries, have a significantly higher proportion of women—44% in each case—up from 40% a decade ago. No chemical field, however, employs more women than men.

Number of workers in chemical industry has grown steadily for past three years



a Seasonally adjusted employment in U.S. chemicals and allied products industry; February, March, and April 1990 figures are preliminary. **Source:** Department of Labor

INDUSTRIAL EMPLOYMENT: Plastics and drugs lead chemical industry gains in 1989

Thousands[a]	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	Annual change 1988–89	Annual change 1979–89
All manufacturing	19,612	19,403	19,024	18,965	19,260	19,378	18,434	18,781	20,170	20,285	21,040	1%	−1%
Chemicals and allied products	1,093	1,065	1,026	1,022	1,044	1,049	1,043	1,075	1,109	1,107	1,109	3	0
Industrial inorganic chemicals	135	133	130	135	142	143	151	161	162	161	162	2	−2
Plastics materials and synthetics	187	178	168	168	172	178	177	185	196	205	212	5	−1
Drugs	241	231	215	208	206	206	201	199	199	196	193	4	2
Soap, cleaners, and toilet goods	161	160	153	147	148	146	142	144	146	141	140	1	1
Paints and allied products	63	64	63	63	64	62	60	60	63	65	69	−2	−1
Industrial organic chemicals	150	147	148	154	160	162	163	171	178	174	171	2	−1
Agricultural chemicals	53	52	51	54	59	61	61	65	70	72	70	2	−3
Miscellaneous chemical products	102	101	97	94	94	92	89	91	94	93	93	1	1
Petroleum and coal products	163	162	164	169	179	189	196	201	214	198	210	1	−3
Rubber and miscellaneous plastics products	840	830	811	790	786	780	711	697	737	727	782	1	1

a Domestic employment. **Source:** Department of Labor

PRODUCTION WORKERS: Chemical employment growing faster than manufacturing as a whole

Thousands[a]	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	Annual change 1988–89	Annual change 1979–89
All manufacturing	13,375	13,254	12,970	12,877	13,092	13,285	12,530	12,742	14,020	14,214	15,068	1%	−1%
Chemicals and allied products	613	596	575	568	578	583	579	599	628	626	633	3	0
Industrial inorganic chemicals	70	67	67	69	72	73	77	86	88	87	88	4	−2
Plastics materials and synthetics	122	116	110	113	114	117	115	119	130	137	144	5	−2
Drugs	106	102	99	96	95	96	98	98	99	97	96	4	1
Soap, cleaners, and toilet goods	102	103	98	93	94	93	89	90	92	96	84	−1	2
Paints and allied products	32	31	31	30	31	30	29	29	31	33	36	3	−1
Industrial organic chemicals	88	85	83	81	82	83	84	86	90	88	89	4	0
Agricultural chemicals	33	33	32	33	37	38	37	40	44	45	45	0	−3
Miscellaneous chemical products	61	59	55	53	54	54	51	51	54	53	53	3	1
Petroleum and coal products	106	105	107	106	109	111	118	120	134	125	137	1	−3
Rubber and miscellaneous plastics products	656	646	629	615	607	608	551	534	569	559	612	2	1

a Domestic employment. **Source:** Department of Labor

EMPLOYMENT OF WOMEN: Chemical industry lags other manufacturing fields

	1988		1978	
	(thousands)	% of total	(thousands)	% of total
All manufacturing	6389.0	33%	6237.0	30%
Chemicals and allied products	310.5	29	258.2	24
Industrial inorganic chemicals	25.9	19	22.1	13
Plastics materials and synthetics	38.2	21	43.5	20
Drugs	100.7	44	74.8	40
Soap, cleaners, and toilet goods	70.1	44	54.5	40
Paints and allied products	12.6	20	12.0	17
Industrial organic chemicals	28.6	20	24.0	14
Agricultural chemicals	8.6	17	9.1	14
Miscellaneous chemical products	25.8	25	18.2	20
Petroleum and coal products	24.3	15	24.6	12
Rubber and miscellaneous plastics products	287.6	35	261.1	35

a Domestic employment. **Source:** Department of Labor

WORKWEEK: Held steady for chemical workers last year

Hours[a]	1989	1988	1987
All manufacturing	41.0	41.1	40.2
Chemicals and allied products	42.4	42.3	41.9
Industrial inorganic chemicals	42.8	43.0	42.1
Plastics materials and synthetics	43.1	43.4	42.1
Drugs	41.7	41.1	41.1
Soap, cleaners, and toilet goods	10.2	40.2	40.5
Paints and allied products	41.8	41.9	41.2
Industrial organic chemicals	44.6	44.1	43.4
Agricultural chemicals	43.4	43.3	42.9
Miscellaneous chemical products	42.4	42.1	41.5
Petroleum and coal products	44.3	44.4	43.8
Rubber and miscellaneous plastics products	41.5	41.7	40.5

a For production workers in domestic employment. **Source:** Department of Labor

EMPLOYMENT OF SCIENTISTS, ENGINEERS: Chemical industry's share is about 10% of total

Thousands[a]	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1978
Total, all industry	725.8	703.8	676.5	626.2	586.5	541.9	509.8	487.8	450.6	423.9	404.4
Chemicals and allied products	74.9	73.0	75.8	71.1	69.8	67.3	61.6	54.7	51.4	50.0	48.3
Industrial chemicals	23.2[b]	24.4	24.9	23.5	25.6	26.6	25.9	21.6	20.9	21.4	21.3
Drugs and medicines	31.2	29.2	31.8	30.8	30.8[b]	28.2	25.6	23.3	21.8	20.8	19.5
Other chemicals	20.5	19.4	19.1	16.7	13.4	12.1	10.1	9.8	8.9	7.8	7.5
Petroleum refining	9.5	8.6	10.4	13.5	13.3	14.7	15.6	13.0	10.8	10.1	9.9

a Full-time equivalent number of R&D scientists and engineers in industry, as of January of each year. b Partly estimated. **Source:** National Science Foundation

3 Employment in the U.S. Chemical Industry

CHEMICAL EMPLOYMENT: Slow recovery continues after sharp 1986–87 cutbacks

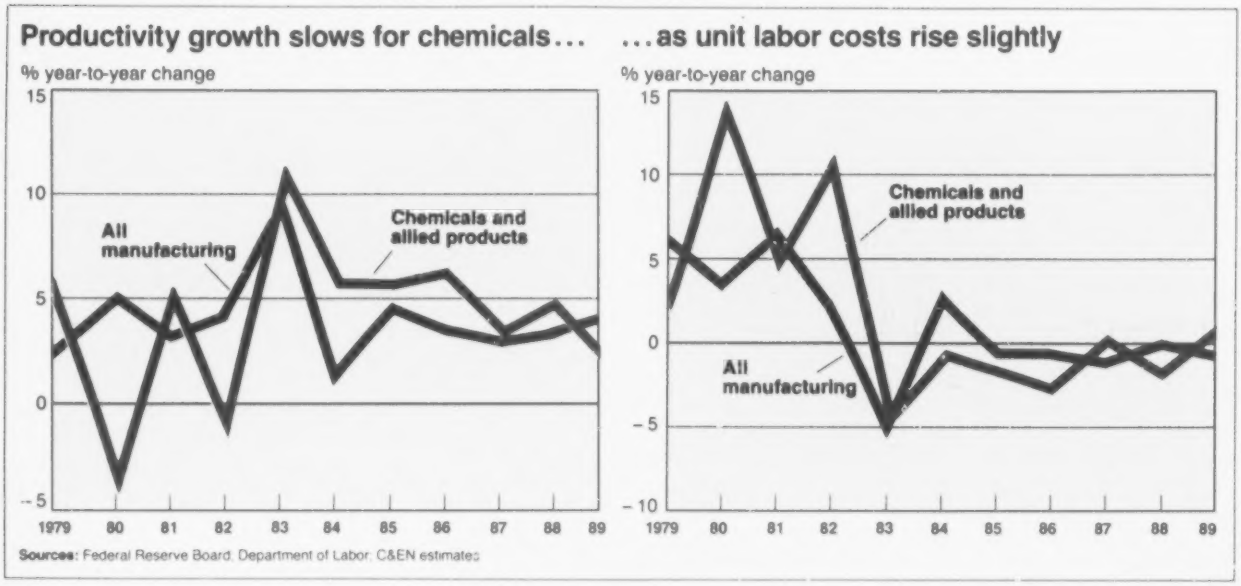
Thousands	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979
Air Products	14.1	13.3	12.1	16.6	18.7	17.7	16.7	18.9	16.2	15.8	14.6
American Cyanamid	35.4	35.5	34.3	34.5	36.4	38.2	38.7	40.2	41.8	42.6	44.2
Betz Laboratories	3.4	3.1	2.0	2.6	2.5	2.5	2.3	2.2	2.2	2.1	2.0
Cabot Corp.	5.5	5.2	5.1	6.6	7.7	7.5	7.2	7.5	7.7	7.6	8.1
Chemed	5.7	5.6	4.8	4.8	4.3	4.3	4.1	3.5	3.6	3.6	3.3
Crompton & Knowles	1.7	1.6	1.3	1.3	2.3	2.3	2.4	2.3	2.5	2.8	3.0
Dow Chemical	62.1	55.5	53.1	51.3	53.2	49.8	54.5	56.6	63.8	56.8	55.9
Ethyl	5.5	10.4	10.0	10.5	10.5	11.0	13.0	14.0	14.5	15.0	16.0
H. B. Fuller	5.4	5.2	4.6	4.5	4.4	4.3	4.1	4.0	3.3	3.4	3.4
W. R. Grace	46.4	45.7	39.4	41.4	116.9	102.6	95.5	82.2	89.0	92.0	82.8
Hercules	23.3	22.7	23.2	25.1	25.4	26.3	24.2	24.5	25.9	26.1	27.4
International Flavors	4.2	4.2	4.1	3.8	3.7	3.7	3.7	3.6	3.6	3.6	3.6
International Minerals	6.9	6.9	12.9	13.9	8.7	9.0	8.4	8.4	10.6	10.6	10.3
Lubrizol	5.3	4.8	4.8	4.8	5.2	4.2	4.2	4.3	4.2	4.2	3.9
Monsanto	42.2	45.6	49.7	51.7	56.1	50.8	48.8	52.2	57.4	61.8	63.9
Nalco Chemical	5.5	5.4	5.1	4.9	5.1	4.8	4.6	4.6	4.7	4.3	4.1
Olin	15.4	16.4	14.1	13.2	14.9	17.8	18.2	17.5	20.3	21.0	21.7
PPG Industries	35.5	36.3	36.8	36.5	37.5	37.7	37.0	37.0	36.6	37.3	38.2
Rohm & Haas	13.0	12.4	12.0	12.1	11.8	11.9	11.4	11.5	13.5	13.2	13.3
Stepan	1.2	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.9
Union Carbide	46.0	44.0	43.1	50.3	91.5	98.4	99.5	103.2	110.3	116.1	115.8
TOTAL EMPLOYEES	**383.7**	**380.8**	**373.6**	**391.3**	**517.7**	**505.7**	**499.3**	**499.1**	**532.6**	**540.6**	**536.4**
ANNUAL CHANGE	**0.8%**	**1.9%**	**–4.5%**	**–24.4%**	**2.4%**	**1.3%**	**0.1%**	**–6.3%**	**–1.5%**	**0.8%**	**4.1%**
SALES PER EMPLOYEE ($ thousands, current)	**$189.5**	**$179.3**	**$160.7**	**$135.8**	**$114.6**	**$115.8**	**$110.4**	**$107.9**	**$109.6**	**$102.0**	**$ 92.9**
SALES PER EMPLOYEE ($ thousands, constant 1982[a])	**$153.9**	**$154.0**	**$151.0**	**$132.5**	**$110.5**	**$112.6**	**$110.1**	**$107.9**	**$111.4**	**$114.5**	**$122.0**

Note: Data are not restated for acquisitions, divestitures, or similar developments. a Based on producer price index for chemicals and allied products. **Source:** Company data

WAGES: Chemical industry hourly earnings edge above $13 per hour in 1989

	Hourly earnings[a]				Weekly earnings[a]			
	1989	1988	1987	1979	1989	1988	1987	1979
All manufacturing	$10.47	$10.18	$ 9.91	$6.40	$429.27	$417.99	$406.31	$269.34
Chemicals and allied products	13.06	$12.67	12.37	7.60	533.74	535.94	523.25	318.44
Industrial inorganic chemicals	14.21	13.87	13.56	8.26	608.19	596.41	574.94	347.75
Plastics materials and synthetics	13.39	13.04	12.60	7.48	577.11	565.94	543.06	314.91
Drugs	12.51	12.07	11.62	6.93	521.67	496.08	483.39	284.82
Soap, cleaners, and toilet goods	11.28	11.05	10.90	7.18	453.46	444.21	447.99	290.79
Paints and allied products	11.65	11.24	10.84	6.80	486.97	470.96	452.03	280.16
Industrial organic chemicals	15.58	15.05	14.89	9.02	694.87	663.71	656.65	391.47
Agricultural chemicals	12.74	12.34	11.92	7.26	552.92	534.32	510.18	311.45
Miscellaneous chemical products	11.92	11.54	11.36	7.06	505.41	485.83	471.44	292.99
Petroleum and coal products	15.44	14.98	14.58	9.36	683.99	665.11	641.52	409.97
Rubber and miscellaneous plastics products	9.42	9.14	8.92	5.97	390.93	381.14	371.07	241.79

a For production workers in domestic employment. **Source:** Department of Labor



Sources: Federal Reserve Board, Department of Labor, C&EN estimates

Productivity of workers in the U.S. chemical industry improved slightly last year. But companies had to pay their production employees more, as well, causing unit labor costs also to rise.

As a result, changes for both productivity and labor costs were less favorable for the chemical industry than for all manufacturing, the first time this has happened since 1983.

Using data from the Federal Reserve Board and the Department of Labor, C&EN calculates that productivity in the chemical industry increased 2.3% in 1989, a considerable slowing from the 4.4% increase that occurred in 1988. In fact, not since 1982, when productivity in the industry actually fell slightly, has the showing been so poor. And the increase for chemicals also was less than that in all manufacturing.

Production of chemicals and allied products increased 6% in 1989, while the Labor Department's index of aggregate weekly hours worked by production employees rose just 3%. By contrast, production in all manufacturing was up almost 4%, while workhours were flat. The result was a 3.8% increase in productivity for manufacturing industries as a whole.

However, while chemical productivity was rising, hourly wages in the industry were increasing a bit faster, so that unit labor costs were higher, as well. According to government figures, hourly production wages rose 3.1% in 1989 from the year before. This resulted in an 0.8% increase in the industry's unit labor costs; in contrast, unit labor costs for chemicals and allied products fell 1.9% in 1988. Last year's increase was only the second in the past eight years, other than a very slight rise that took place in 1987.

For all manufacturing, unit labor costs delcined last year, after having been flat in 1988. C&EN's calculations show these costs dropping 0.9% in 1989 from 1988 levels as the 2.9% rise in hourly production wages was outstripped by a 3.8% increase in output per workhour.

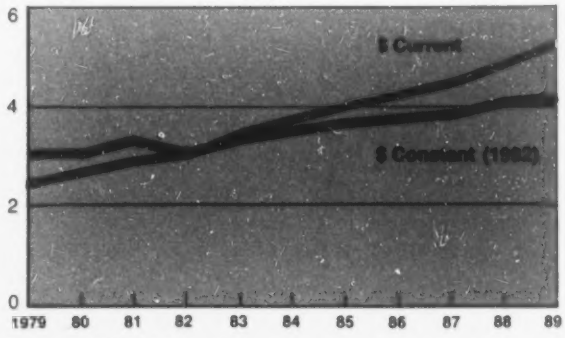
PRODUCTIVITY: Modest growth in chemical industry keeps labor costs relatively low

Indexes, 1977 = 100	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979
CHEMICALS AND ALLIED PRODUCTS											
Production	160.1	151.2	140.2	133.0	127.1	121.6	113.9	103.8	112.6	106.4	113.3
Workhours	101.3	98.3	94.7	92.6	94.1	95.0	93.9	95.2	101.7	101.0	103.1
Productivity[a]	158.0	154.5	148.0	143.6	135.1	128.0	121.3	109.0	110.7	105.3	109.9
Hourly production wages	203.1	197.0	192.4	186.1	180.1	172.7	164.8	155.0	141.8	129.2	118.2
Unit labor costs[b]	128.5	127.5	130.0	129.6	133.3	134.9	135.9	142.2	128.1	122.6	107.6
ALL MANUFACTURING											
Production	148.2	142.7	134.7	129.2	126.4	123.4	113.9	102.2	110.5	108.2	110.7
Workhours	96.1	96.1	93.4	92.0	93.1	94.8	88.2	87.0	97.9	98.9	106.4
Productivity[a]	154.2	148.5	144.2	140.4	135.8	130.2	129.1	117.5	112.9	109.4	104.0
Hourly production wages	184.3	179.1	174.0	171.1	166.9	161.5	155.4	149.6	140.7	128.1	118.0
Unit labor costs[b]	119.5	120.6	120.7	121.8	122.9	124.1	120.3	127.4	124.7	117.1	113.4

a Productivity is output per workhour, calculated by dividing indexes for production by indexes for workhours of production employees. b Unit labor costs are labor costs per unit of output, calculated by dividing indexes for wages by indexes for output per workhour. Sources: Federal Reserve Board, Department of Labor, C&EN estimates

4 Markets for the U.S. Chemical Industry

Gross national product

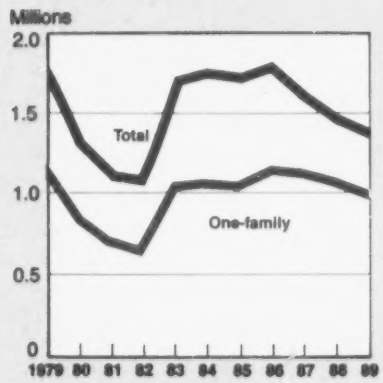


Source: Department of Commerce

Any question why last year, although a strong one by most past standards for chemical producers, was not quite the banner year that 1988 had been can be settled by a glance at the data graphed on these two pages. The U.S. economy generally continued to be healthy; the nation's total output of goods and services and spending on the part of its consumers both increased nearly 3%, after adjustment for inflation. That's not quite so good a performance as earlier in the current economic upswing, but still good enough to keep industry robust and demand for chemicals high.

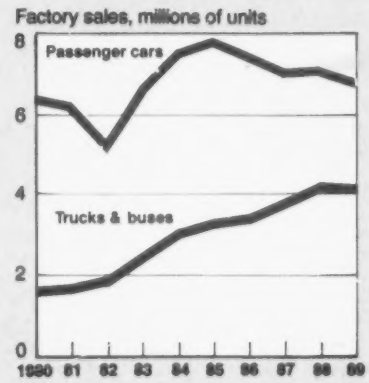
Even so, for some of the key markets of the chemical industry, 1989 was a downbeat year. For one of the biggest outlets for plastics, synthetic fibers, and coatings, new housing activity slackened for the third year in a row, with the number of housing starts declining 7% to the lowest level since the recession year of 1982. This year, moreover, home building still is in the doldrums.

Housing starts



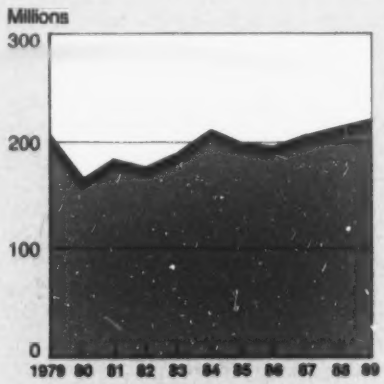
Source: Bureau of the Census

Motor vehicles



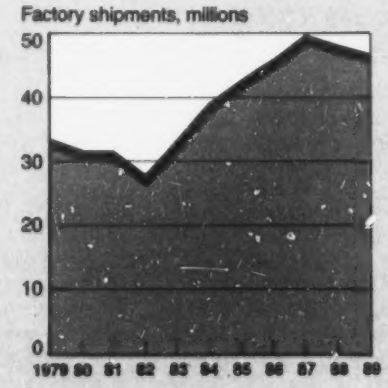
Source: Motor Vehicle Manufacturers Association

Tires and tubes



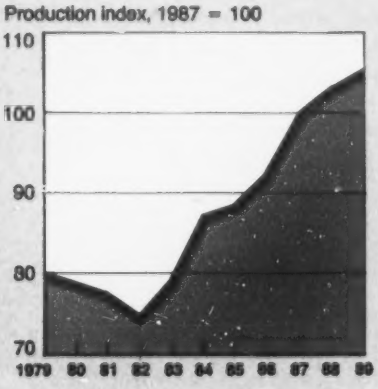
Source: Rubber Manufacturers Association

Major home electrical appliances



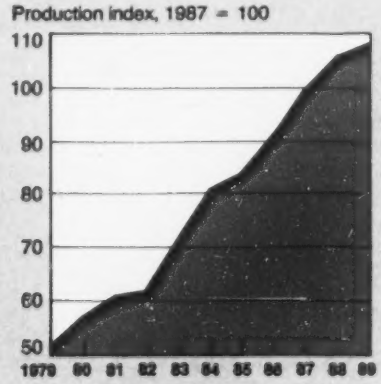
Source: Association for Home Appliance Manufacturers

Furniture and fixtures



Source: Federal Reserve Board

Miscellaneous plastics products

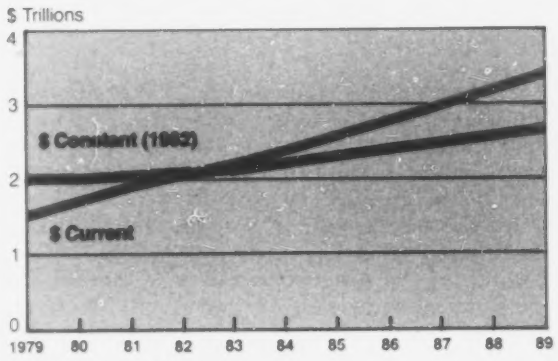


Source: Federal Reserve Board

U.S. assembly lines also turned out fewer motor vehicles last year. Production of passenger cars fell 4% to the fewest since 1983, while the decade-old advance in truck assemblies came to a halt. This year, with sales trailing last year's volume, auto production through the first five months has been cut by more than 20% from a year ago. Last year cutbacks showed up, as well, for major home appliances such as refrigerators, ranges, and dishwashers. Even the recent boom in demand for microwaves ground to a halt.

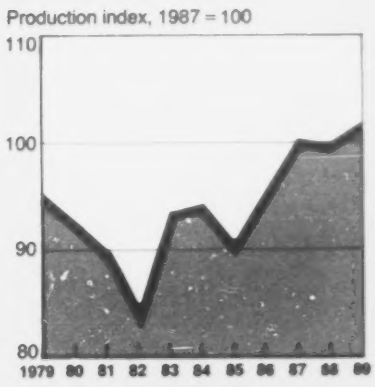
Not all the industries that consume chemical products were hurting, to be sure. Buoyed by consumer spending, apparel makers hiked production 2%, for instance. And output also edged higher for furniture and floor coverings. This year, moreover, with consumers likely to again be spending more than ever and the pace of the economy expected to pick up, demand for chemicals is not likely to deteriorate further.

Personal consumption expenditures



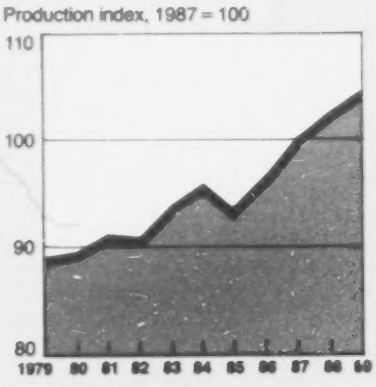
Source: Department of Commerce

Textile mill products



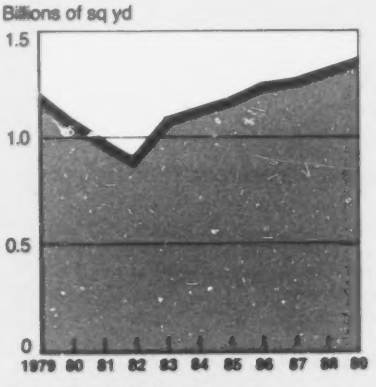
Source: Federal Reserve Board

Apparel



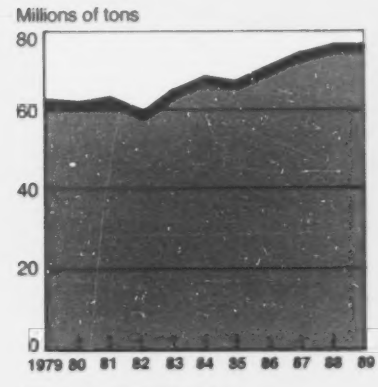
Source: Federal Reserve Board

Floor coverings



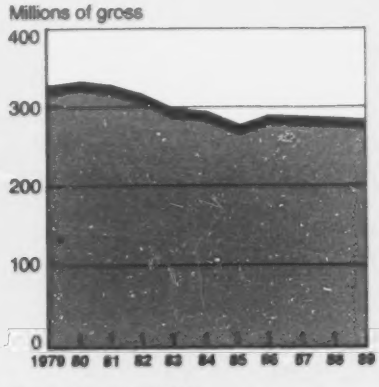
Source: Bureau of the Census

Paper and paperboard



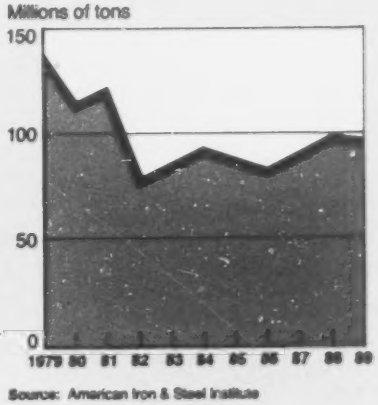
Source: American Paper Institute

Glass containers



Source: Bureau of the Census

Steel



Source: American Iron & Steel Institute

Gains continue for U.S. trade in chemicals

Last year was another good one for U.S. foreign trade. The troublesome trade deficit, which has persisted throughout most of the 1970s and all of the 1980s, dropped sharply in 1989 for the second year in a row. And the surplus in U.S. chemical trade, one of the few consistently bright spots in the overall U.S. trade picture, continued to grow, as it has since 1985.

Total U.S. exports hit $364 billion last year, up 13% from 1988. That's only half the increase recorded in 1988, but coupled with an increase of only 7% in imports, to $473 billion, it still was enough to shave almost $10 billion off the overall deficit. At the end of last year, the deficit stood at nearly $109 billion, still uncomfortably high, to be sure, but not nearly so bad as the $153 billion deficit that existed as recently as 1987.

Meanwhile, U.S. trade in chemicals continues to show its characteristic strength. Exports increased 13% last year to a record $36.5 billion. Only West Germany, which exported $44 billion worth of chemicals, surpassed the U.S. in its foreign sales of chemicals. Growth in imports of chemicals into the U.S., on the other hand, was much lower. Imports topped the $20 billion mark for the first time, but increased only 4% for the year. As a result, the U.S. trade surplus in chemicals rose from $12.4 billion in 1988 to a heady $15.7 billion.

U.S. chemical producers chalked up their impressive performance in sales abroad despite appreciation of the U.S. dollar against most foreign currencies. A stronger dollar, of course, makes U.S. exports more costly overseas and hence less competitive in international markets. Nevertheless, the U.S. upped its share of world chemical exports from 1988's 13.5% to 14.6% last year.

U.S. TOTAL TRADE BALANCE:
Rising exports shrink deficit

$ Billions	1989	1988	1987	1979
Total exports	$ 364.3	$ 322.4	$ 252.9	$181.6
Total imports	472.9	440.9	405.9	206.3
Trade balance	-108.6	-118.5	-153.0	-24.7

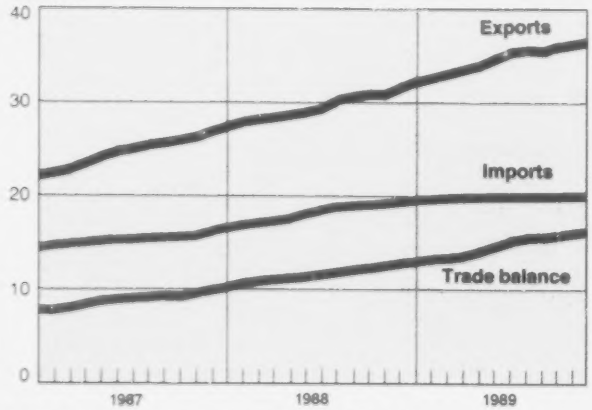
Source: Department of Commerce

U.S. CHEMICAL TRADE BALANCE:
Surplus expands as exports strengthen

$ Millions	1989	1988	1987	1979
Chemical exports	$36,485	$32,300	$26,381	$17,306
Chemical imports	20,752	19,876	16,213	7,485
Chemical trade balance	15,733	12,424	10,168	9,821

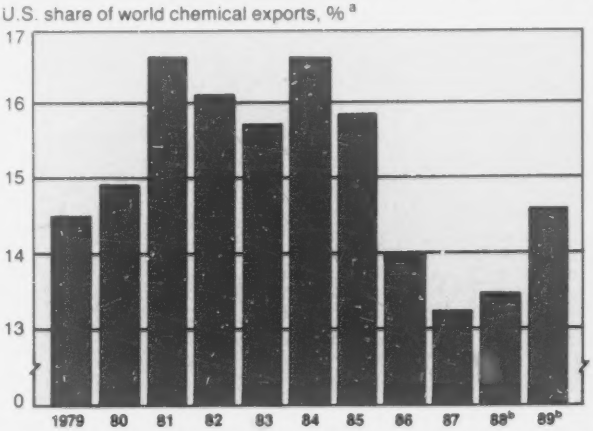
Source: Department of Commerce

U.S. chemical trade surplus widens more...



a Running 12-month totals. Source: Department of Commerce

...as U.S. exports win bigger market share



a U.S. chemical exports as a percentage of total world chemical exports less U.S. chemical imports. b C&EN estimates.

U.S. TRADE: Most markets show gains

$ Millions	1989	1988	1987	1979
U.S. CHEMICAL EXPORTS				
Canada	$ 4,210	$ 3,800	$ 3,277	$ 1,994
Latin America	5,419	5,145	4,407	3,814
Western Europe	10,891	9,276	7,987	5,585
Eastern Europe	409	341	344	200
Communist Asia	1,137	1,388	808	125
Japan	4,664	4,002	3,422	1,652
Middle East	542	549	423	387
Rest of Asia	6,624	5,782	4,121	2,204
Australia	1,364	1,080	834	608
Africa	702	600	500	465
Other	522	337	258	272
TOTAL	**$36,485**	**$32,300**	**$26,381**	**$17,306**
U.S. CHEMICAL IMPORTS				
Canada	$ 3,938	$ 3,782	$ 3,052	$ 2,362
Latin America	1,200	1,324	942	405
Western Europe	10,582	10,212	8,220	3,449
Eastern Europe	208	219	165	107
Communist Asia	273	234	200	60
Japan	2,373	2,187	2,150	616
Middle East	371	298	238	48
Rest of Asia	985	824	698	148
Australia	291	322	235	158
Africa	61	103	74	49
Other	474	371	239	83
TOTAL	**$20,752**	**$19,876**	**$16,213**	**$ 7,485**

Source: Department of Commerce

WORLD TRADE: U.S. leads in export growth

$ Millions	1989	1988	1987	1979
CHEMICAL EXPORTS				
World	$270,480[a]	$259,400[a]	$214,824	$126,530
U.S.	36,485	32,300	26,381	17,306
Canada	6,184	6,387	4,736	2,897
EC, 12 countries	147,406	144,275	119,918	70,889
Belgium-Luxembourg	14,010	13,043	10,444	6,644
France	23,980	23,634	20,439	11,646
Italy	10,782	10,528	8,745	5,810
Netherlands	19,321	18,839	16,740	10,325
U.K.	20,038	20,215	17,285	10,451
West Germany	44,184	43,848	38,401	22,415
Switzerland	10,890	11,137	10,002	5,354
Japan	14,776	13,964	11,662	6,100
CHEMICAL IMPORTS				
U.S.	$ 20,752	$ 19,876	$ 16,213	$ 7,485
Canada	7,791	6,976	5,333	3,076
EC, 12 countries	120,108	113,335	96,683	54,450
Belgium-Luxembourg	11,648	10,672	8,698	5,376
France	20,637	19,619	16,892	9,890
Italy	17,220	16,084	13,689	6,992
Netherlands	11,577	10,840	9,653	5,760
U.K.	17,431	16,793	13,680	7,232
West Germany	23,361	24,274	21,503	12,399
Switzerland	6,552	6,731	5,376	3,156
Japan	15,948	14,830	11,845	5,178

a C&EN estimates. **Sources:** United Nations, Organization for Economic Cooperation & Development, European Community, individual government agencies

U.S. TRADE, BY PRODUCTS: Export surge led by organic chemicals and plastics

	Chemical exports				Chemical imports			
$ Millions	1989	1988	1987	1979	1989	1988	1987	1979
Organic chemicals	$10,609	$ 9,381	$ 7,550	$ 5,055	$ 7,042	$ 6,953	$ 5,408	$2159
Plastics and resins	7,928	7,277	5,492	3,241	3,316	2,433	1,987	626
Medicinals and pharmaceuticals	3,660	3,941	3,182	1,591	2,086	1,859	1,456	441
Inorganic chemicals	2,986	2,702	2,112	2,712	2,239	2,498	2,030	1106
Fertilizers, manufactured	2,821	2,498	2,259	1,404	999	1,021	795	976
Pesticides and disinfectants[a]	32	910	732	516	28	577	398	190
Radioactive materials	1,333	868	1,017	937	992	1,098	1,012	953
Flavors, perfumes, cosmetics, and toiletries	1,053	709	579	399	968	932	796	263
Pigments, paints, and varnishes	772	449	411	273	515	395	427	76
Cleaning and polishing materials	416	395	357	290	197	260	205	73
Dyeing, tanning, and coloring materials	325	258	217	177	618	610	621	185
Explosives and pyrotechnics	123	91	91	62	131	118	110	58
Miscellaneous	4,427	2,821	2,382	1,649	1,621	1,122	968	379
TOTAL	**$36,485**	**$32,300**	**$26,381**	**$17,306**	**$20,752**	**$19,876**	**$16,213**	**$7485**

a Revised classification results in 1989 data being not comparable with previous years. **Source:** Department of Commerce

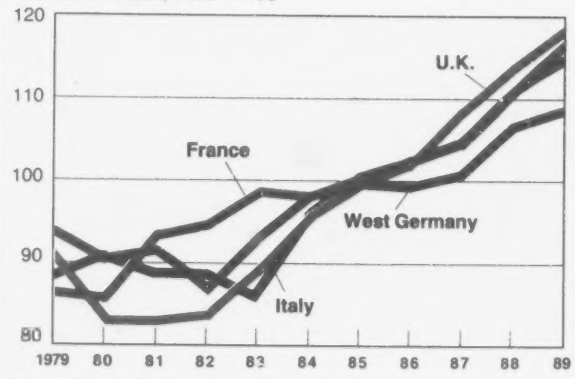
Profitability remains relatively strong

Mergers and divestitures led to several shifts among the lineup of top Western European chemical companies last year, with one completely new key player, Italy's Enimont, appearing for the first time. However, as in previous years, the big three West German chemical firms BASF, Hoechst, and Bayer were the sales leaders, with the U.K.'s ICI following them closely.

Throughout Western Europe, 1989 was a solidly profitable year, one of the best on that score, in fact, in the industry's history. In past years, when business was generally good, chemical companies tended to produce as much as their plants could turn out, chasing volume rather than profits. Last year, however, they showed a marked restraint, so that production of many major chemicals declined.

Despite the cutbacks in output, though, the industry continued to contribute favorably to the balance of trade for nearly all countries in the region.

Chemical growth strongest in France, U.K.



Source: European Chemical Industry Federation (CEFIC)

CHEMICAL INDUSTRY TRENDS: Sales and output growth slowed in 1989 but prices rose

$ Billions (U.S.)	1989	1988	1987	1986	1985
WEST GERMANY					
Sales	$ 85.0	$ 85.7	$ 78.0	$ 64.5	$ 50.5
Exports	45.7	45.5	40.2	33.2	26.1
Imports	27.3	25.6	22.6	18.8	15.0
Capital spending	6.1	6.0	5.3	3.5	2.4
Production index[a]	107.8	106.5	101.1	99.1	100.0
Price index[a]	95.2	92.4	91.1	94.2	100.0
Employees (thousands)	581	575	572	567	557
FRANCE[b]					
Sales	$ 54.6	$ 53.5	$ 47.4	$ 40.7	$ 31.8
Exports	21.1	21.9	19.0	15.7	12.8
Imports	19.6	18.2	15.4	12.5	10.0
Capital spending	3.2	2.9	2.5	1.9	1.3
Production index[a]	117.0	111.4	104.1	101.0	100.0
Price index[a]	103.6	98.8	96.3	97.5	100.0
Employees (thousands)	268	257	268	268	272
U.K.[b]					
Sales	$ 44.2	$ 44.0	$ 36.9	$ 30.6	$ 26.3
Exports	20.2	20.2	17.3	14.3	12.1
Imports	17.1	16.6	13.7	11.0	9.0
Capital spending	3.4	3.1	2.3	1.9	1.6
Production index[a]	118.7	113.9	109.0	101.1	100.0
Price index[a]	116.4	111.5	105.8	101.4	100.0
Employees (thousands)	320	320	336	336	336

$ Billions (U.S.)	1989	1988	1987	1986	1985
ITALY					
Sales	$ 44.2	$ 43.8	$ 37.5	$ 30.7	$ 24.5
Exports	11.5	10.9	9.3	7.8	6.6
Imports	18.4	17.1	14.7	12.0	9.3
Capital spending	2.3	2.1	1.8	1.3	0.9
Production index[a]	114.6	112.5	103.6	101.4	100.0
Price index[a]	110.2	107.5	100.4	97.3	100.0
Employees (thousands)	220	223	225	230	233
SPAIN[c]					
Sales	$ 32.5	$ 30.4	$ 25.8	$ 20.7	$ 16.1
Exports	5.1	4.9	4.2	3.1	2.9
Imports	8.9	7.6	6.3	4.7	3.1
Capital spending	0.8	0.7	0.5	0.4	0.3
Production index[a]	128.6	122.5	112.4	105.0	100.0
Price index[a]	108.3	104.6	102.5	101.0	100.0
Employees (thousands)	240	239	239	239	240
BELGIUM[b,c,d]					
Sales	$ 23.5	$ 22.7	$ 19.8	$ 17.2	$ 14.1
Exports	17.6	16.4	14.7	12.2	9.6
Imports	14.5	13.5	10.7	8.6	6.9
Capital spending	1.8	1.6	1.0	0.7	0.4
Production index[a]	125.4	120.2	110.6	102.6	100.0
Price index[a]	102.0	96.5	94.0	97.7	100.0
Employees (thousands)	95	92	91	91	90

$ Billions (U.S.)	1989	1988	1987	1986	1985
NETHERLANDS					
Sales	$ 22.4	$ 22.4	$ 19.5	$ 16.0	$ 13.9
Exports	22.1	21.8	19.0	15.7	12.9
Imports	13.6	12.6	11.5	9.5	8.0
Capital spending	2.0	1.5	1.5	1.2	0.8
Production index[a]	117.0	112.0	104.0	100.0	100.0
Price index[a]	92.0	88.0	87.0	85.4	100.0
Employees (thousands)	93	92	91	91	89
SWITZERLAND[b]					
Sales	$ 12.6	$ 12.7	$ 11.5	$ 9.3	$ 6.7
Exports	10.9	10.8	9.8	7.9	5.7
Imports	6.6	6.4	5.6	4.7	3.6
Production index[a]	119.0	109.4	105.3	102.1	100.0
Price index[a]	93.0	91.9	90.8	97.3	100.0
Employees (thousands)	72	70	69	68	66
SWEDEN					
Sales	$ 7.4	$ 7.5	$ 6.3	$ 5.0	$ 4.1
Exports	3.7	3.6	3.0	2.5	1.9
Imports	4.7	4.6	3.9	3.2	2.7
Capital spending	0.6	0.5	0.5	0.4	0.3
Production index[a]	118.4	119.6	106.3	99.3	100.0
Price index[a]	116.0	110.5	103.2	101.6	100.0
Employees (thousands)	42	43	45	42	43
AUSTRIA[c]					
Sales	$ 6.9	$ 7.0	$ 6.1	$ 3.5	$ 2.9
Exports	3.0	3.0	2.4	1.9	1.6
Imports	4.0	3.8	3.4	2.7	2.1
Capital spending	0.7	0.6	0.5	0.5	0.3
Production index[a]	104.1	100.0	87.3	100.8	100.0
Employees (thousands)	57	56	55	35	36
PORTUGAL					
Sales	na	$ 4.8	$ 1.7	$ 1.5	$ 1.1
Exports	$ 0.8	0.8	0.6	0.5	0.4
Imports	2.1	1.9	1.8	0.9	0.6
Production index[a]	170.8	163.2	151.9	112.0	100.0
Employees (thousands)	na	51	51	51	51

$ Billions (U.S.)	1989	1988	1987	1986	1985
IRELAND[b]					
Sales	$ 3.7	$ 3.1	$ 2.5	$ 2.2	$ 1.8
Exports	3.3	2.5	1.9	1.7	1.5
Imports	2.2	2.0	1.7	1.4	1.2
Production index[a]	150.5	124.1	108.1	99.2	100.0
Price index[a]	96.8	93.4	91.7	96.8	100.0
Employees (thousands)	13	12	12	12	12
DENMARK					
Sales	$ 3.6	$ 3.6	$ 3.7	$ 2.8	$ 2.1
Exports	2.8	2.7	2.4	1.9	1.5
Imports	3.1	3.1	2.8	2.4	1.9
Capital spending	0.3	0.3	0.3	0.2	0.1
Production index[a]	109.0	107.0	105.4	108.0	100.0
Price index	109.0	104.0	99.0	97.4	100.0
Employees (thousands)	26	26	26	26	25
FINLAND					
Sales	na	$ 3.5	$ 3.6	$ 3.1	$ 2.4
Exports	$ 0.8	0.6	0.6	1.2	1.0
Imports	1.3	1.0	1.1	2.1	1.6
Capital spending	na	0.4	0.5	0.4	0.3
Production index[a]	116.7	113.4	92.1	102.1	100.0
Price index[a]	na	102.4	95.0	95.5	100.0
Employees (thousands)	na	20	24	24	25
NORWAY					
Sales	$ 3.3	$ 3.1	$ 2.9	$ 2.3	$ 2.0
Exports	1.9	1.9	1.6	1.3	1.2
Imports	1.9	1.9	1.6	1.4	1.1
Capital spending	na	0.2	0.2	0.2	0.1
Production index[a]	109.0	103.0	103.0	100.0	100.0
Price index[a]	122.0	114.0	106.0	101.5	100.0
Employees (thousands)	14	14	15	15	15

a 1985 = 100. b Excludes fibers. c Includes rubber and plastics processing. d Includes Luxembourg for exports and imports. na = not available. **Sources:** National agencies and European Chemical Industry Federation (CEFIC)

NOTE ON CURRENCY CONVERSION

For monetary statistics in this section, European currencies were converted to U.S. dollars by the following conversion rates:

	$1.00 (U.S.) is equivalent to:				
	1989	1988	1987	1986	1985
Austria (schillings)	13.23	12.35	12.65	15.27	20.69
Belgium (francs)	39.40	36.77	37.33	44.67	59.38
Denmark (crowns)	7.31	6.73	6.84	8.09	10.60
Finland (marks)	4.29	4.18	4.40	5.07	6.20
France (francs)	6.38	5.96	6.01	6.93	8.99
Ireland (pounds)	0.705	0.654	0.672	0.745	0.935
Italy (lire)	1372	1302	1297	1491	1909
Netherlands (guilders)	2.12	1.98	2.03	2.45	3.32
Norway (crowns)	6.90	6.52	6.74	7.39	8.60
Portugal (escudos)	157.5	144.0	141.0	150.0	170.0
Spain (pesetas)	118.38	116.49	123.48	140.05	170.04
Sweden (crowns)	6.45	6.13	6.34	7.14	8.60
Switzerland (francs)	1.64	1.46	1.49	1.80	2.46
U.K. (pounds)	0.610	0.562	0.610	0.682	0.772
West Germany (marks)	1.88	1.76	1.80	2.17	2.94

Source: International Monetary Fund

MAN-MADE FIBERS: Production expands only moderately overall

Millions of lb	1989		1988		1987		1986		1985		Change, 1988–89	
	Non-cellulosics	Cellulosics	Non-cellulosics	Cellulosics	Non-cellulosics	Cellulosics	Non-cellulosics	Cellulosics	Non-cellulosics	Cellulosics	Non-cellulosics	Cellulosics
West Germany	1841	394	1817	376	1806	356	1738	354	1764	372	1%	5%
Italy	1412	77	1452	70	1441	64	1430	66	1409	67	−3	10
Turkey	645	20	592	20	572	18	504	18	409	18	9	0
Spain	592	88	590	81	591	78	601	80	633	80	0	9
U.K.	493[a]	255[b]	515[a]	238[b]	513[a]	208[b]	524[a]	207[b]	557[a]	247[b]	−4	7
Benelux countries	521	119	385	119	399	109	379	108	365	95	35	0
France	392	4	392	33	382	50	392	45	427	44	0	−88
Switzerland	264	0	255	0	227	0	216	0	226	0	4	—
Ireland	207	0	176	0	172	0	162	0	140	0	18	—
Portugal	141	2	128	2	139	2	136	2	134	1	10	0
Austria	77	301	70	290	68	264	61	271	63	265	10	4
Finland	7	143	7	132	4	118	3	121	3	134	0	8

a Includes cellulose acetate filament. b Excludes cellulose acetate filament. **Source:** Comité International de la Rayonne et des Fibres Synthétiques

PRODUCTION: Declines far outnumber increases among major chemicals in 1989

Millions of lb	1989	1988	1987	1986	Change 1988–89
FRANCE					
Sulfuric acid	9141	8846	8618	8826	3%
Hydrochloric acid	1525	1507	1427	1381	1
Chlorine	3185	3121	2971	3151	2
Sodium hydroxide	3370	3258	3123	3304	3
Ammonia	3249	4031	4466	4455	−19
Benzene	1474	1544	1439	1332	−5
Toluene	74	104	72	83	−29
Xylenes	372	493	284	250	−25
Ethylene	5562	5361	5319	4980	4
Propylene	3480	3298	3073	2283	6
Butadiene	724	737	677	641	−2
Formaldehyde	221	193	180	176	14
Polyethylene	2549	2620	2523	2471	−3
Polypropylene	1544	1278	1159	1034	21
Polystyrene	1192	1177	1166	1089	1
Polyvinyl chloride	2350	2237	2039	1960	5
Synthetic rubber	1300	1251	1184	1193	4
Phosphate fertilizers[a]	594	700	1209	1267	−15
ITALY					
Sulfuric acid	7747[b]	9478	9590	9170	−18
Nitric acid	2436[b]	2625	2629	2402	−7
Hydrochloric acid	1390[b]	2218	1496	na	−37
Phosphoric acid	610[b]	785	843	829	−22
Chlorine	2632[b]	2385	2294	2106	−1
Sodium hydroxide	2602[b]	2618	2676	2294	−1
Sodium perborate	271[b]	242	245	212	12
Ammonia	3849[b]	3846	3839	4155	0
Benzene	1433[b]	1368	1311	1107	5
Toluene	326[b]	480	402	512	−32
Xylenes	1025[b]	986	1067	893	4
Formaldehyde	257[b]	277	297	297	−7
Acetic acid	106[b]	145	140	116	−27
Carbon black	442[b]	442	420	418	0
Polyethylene	1927[b]	1822	1691	1504	−6
Polystyrene	619[b]	627	664	785	−1
Polyvinyl chloride	1819[b]	1740	1380	1408	−5
Nitrogen fertilizers[c]	6114[b]	7176	6999	6948	−15
U.K.					
Sulfuric acid	4744	4967	4797	5125	−4
Hydrochloric acid[d]	366	368	384	346	−6
Chlorine	na	na	2256	2143	—
Benzene	2292	2072	2005	1876	11
Ethylene	4346	4464	3955	3828	−3
Propylene	1753	2985	1929	1901	−41%
Butadiene	497	527	509	424	−6
Titanium dioxide[d]	593	586	562	506	1
Acetone	287	280	259	271	2
Formaldehyde	189	246	250	227	−23
Polyethylene	989[b]	1015	876	940	−3
Polypropylene	657[b]	692	611	652	−5
Polyvinyl chloride	383[b]	353	390	400	8
Synthetic rubber	685	688	565	636	0
WEST GERMANY					
Sulfuric acid	7165	7186	7260	7344	0
Hydrochloric acid	2107	2160	2179	2048	−2
Nitric acid	4807	5098	5818	6210	−6
Chlorine	7574	7701	7595	7538	−2
Sodium hydroxide	7370	7602	7523	7485	−3
Sodium carbonate	3175	3089	3195	3173	3
Sodium sulfate	379	385	361	359	−2
Carbon black	884	836	796	844	6
Ammonia	4573	4816	5098	4146	−5
Benzene	3443	3536	3316	3373	−3
Toluene	919	1013	884	1052	−9
Xylenes	1345	1296	1102	1190	4
Aniline	376	386	309	408	−3
Ethylene	6588	6889	6118	5868	−4
Propylene	3819	3396	3467	3093	12
Butadiene	1579	1677	1543	1505	−6
Ethylene oxide	1482	1381	1223	1098	7
Ethylene glycol	543	521	536	500	4
Propylene oxide	1299	1209	1181	1174	7
Propylene glycol	399	427	379	395	−7
n-Butanol	741	685	689	689	8
Acetaldehyde	709	789	727	686	−10
Acetic acid	701	754	704	653	−7
Ethanol	224	228	240	217	−2
Methanol	1535	na	na	1016	—
Formaldehyde	1534	1505	1341	1265	2
Phthalic anhydride	506	612	522	433	−17
Polyethylene	3064	3235	2980	2785	−5
Polyvinyl chloride	2948	3105	2904	2732	−5
Synthetic rubber	1119	1101	1035	1026	2
Nitrogen fertilizers[c]	1500[e]	na	1674[f]	1684[f]	—
Phosphate fertilizers[a]	197	na	na	311	—

a As P_2O_5. b C&EN estimates. c As N. d Manufacturers' sales. e Includes calcium cyanide fertilizers. f Excludes calcium cyanamid fertilizers. na = not available. **Sources:** Government agencies for each country

COMPANY RESULTS: **Profitability remains strong and capital and R&D spending edge higher**

$ Millions	Net sales	Net income	Profit margin	Capital spending	R&D spending	Employees (thousands)
BASF (West Germany)						
1989	$25,328.2	$1071.9	4.2	$2104.3	$1039.4	137.0
1988	24,925.0	813.8	3.3	1985.8	1016.5	134.8
1987	22,354.4	586.1	2.6	1532.2	896.1	133.8
1986	18,650.2	419.4	2.2	1224.4	676.5	131.5
Hoechst (West Germany)						
1989	$24,413.8	$1133.0	4.6%	$1700.5	$1394.1	169.3
1988	23,275.0	1144.9	4.9	1579.5	1372.7	164.5
1987	20,531.1	848.9	4.1	1330.0	1231.7	167.8
1986	17,518.0	644.7	3.7	1234.6	985.3	181.2
Bayer (West Germany)						
1989	$23,031.4	$1125.5	4.9%	$1833.5	$1433.5	170.2
1988	22,993.2	1090.3	4.7	1786.9	1397.7	165.7
1987	20,635.0	857.8	4.2	1425.0	1301.7	164.4
1986	18,778.3	687.1	3.7	1093.5	955.8	173.0
ICI (U.K.)						
1989	$21,591.8	$1524.6[a]	7.1%	$1770.5	$1047.5	133.8
1988	20,816.7	1567.6[b]	7.5	1443.1	1005.3	130.4
1987	18,234.4	1245.9	6.8	1160.7	755.7	127.8
1986	14,862.2	879.8[c]	5.9	942.8	573.3	121.8
Ciba-Geigy (Switzerland)						
1989	$12,565.9	$ 949.4	7.5%	$1211.6	$1265.2	92.6
1988	12,087.0	907.5	7.5	1106.8	1230.8	88.8
1987	10,579.9	738.3	7.0	918.1	1122.8	86.1
1986	8,863.9	645.0	7.3	684.4	903.9	82.2
Rhone-Poulenc (France)						
1989	$11,452.7	$ 641.4	5.6%	$1099.7	$ 662.9	85.6
1988	10,962.1	580.0	5.3	990.1	641.4	79.7
1987	9,344.3	392.7	4.2	830.4	585.4	83.0
1986	7,603.8	289.8	3.8	732.5	426.3	78.0
Enimont (Italy)						
1989	$11,452.7	$ 521.9	4.7%	$1445.5	na	52.7
1988[d]	11,261.1	627.5	5.6	920.1	na	54.7
1987	na	na	na	na	na	na
1986	na	na	na	na	na	na
Norsk Hydro (Norway)						
1989	$ 9,612.9	$ 389.4	4.1%	$1316.8	$ 117.5	32.9
1988	9,206.7	526.7	5.7	1355.2	113.5	39.5
1987	8,086.5	311.0	3.8	1451.0	97.2	39.1
1986	7,341.0	(41.4)[e]	—	1562.7	81.2	43.1
Akzo (Netherlands)						
1989	$ 8,837.8	$ 450.1	5.1%	$ 613.2	$ 426.4	70.9
1988	8,374.2	446.0	5.3	641.4	409.0	71.1
1987	7,652.7	354.6[f]	4.6	539.4	362.1	67.4
1986	6,373.5	366.5[g]	5.7	451.4	304.5	68.4
Degussa (West Germany)						
1989[h]	$ 7,636.7	$ 93.1	1.2%	$ 282.4	$ 224.5	33.7
1988[h]	7,730.1	83.0	1.1	255.3	213.1	32.4
1987[h]	6,510.6	67.2	1.0	230.9	150.0	30.8
1986[h]	5,010.1	53.0	1.1	212.0	108.3	25.0

$ Millions	Net sales	Net income	Profit margin	Capital spending	R&D spending	Employees (thousands)
Sandoz (Switzerland)						
1989	$ 7,620.1	$584.1	7.7%	$656.1	$673.2	50.7
1988	6,986.3	521.2	7.5	573.3	624.7	48.0
1987	6,026.2	420.8	7.0	421.5	540.3	44.0
1986	4,645.0	300.6	6.5	306.1	414.4	42.6
Solvay (Belgium)						
1989	$ 6,517.8	$524.6[i]	8.0%	$781.7	$304.6	45.1
1988	6,893.3	410.9[j]	6.0	644.5	293.4	44.3
1987	5,989.8	325.9[k]	5.4	498.3	247.1	45.0
1986	4,842.5	222.3[l]	4.6	517.1	192.6	44.8
Hoffmann-La Roche (Switzerland)						
1989	$ 5,984.1	$519.5	8.7%	$553.7	$865.2	50.2
1988	5,952.3	439.4	7.4	446.6	828.9	49.7
1987	5,171.1	323.5	6.3	348.8	715.8	47.5
1986	4,345.7	231.1	5.3	293.7	623.7	46.5
DSM (Netherlands)						
1989	$ 5,081.1	$488.2[m]	9.6%	$820.8	$188.7	30.0
1988	5,111.6	399.5[n]	7.8	667.7	181.8	28.6
1987	4,422.6	260.6[o]	5.9	431.0	140.4	27.9
1986	3,670.6	198.0[p]	5.4	329.0	91.8	27.3
Montedison (Italy)						
1989	$ 4,140.7	$263.8[q]	6.4%	$636.6	$315.6	22.0
1988[d]	4,077.8	376.3	4.4	457.0	259.8	22.4
1987	10,641.2	436.7	4.1	786.3	290.9	47.9
1986	8,607.6	(46.1)[e,r]	—	570.8	207.9	66.6
BOC International (U.K.)						
1989	$ 3,785.4	$375.9	9.9%	$565.2	$ 89.5	38.4
1988	3,771.4	365.1[s]	9.7	523.5	83.3	38.8
1987	3,211.6	273.4[t]	8.5	362.5	61.5	35.5
1986	2,851.3	10.7[u]	0.4	347.4	55.7	37.7
Nobel Industries (Sweden)						
1989	$ 3,424.5	$214.0	6.2%	$224.7	na	22.2
1988	3,488.1	152.3	4.4	176.3	na	22.1
1987	2,195.6	98.1[v]	4.5	162.9	na	18.1
1986	1,615.5	64.6[w]	3.3	108.3	na	16.3
Courtaulds (U.K.)						
1989[x]	$ 3,121.4	$206.6[y]	6.6%	na	na	24.0
1988[x,d]	2,932.4	197.5[z]	6.7	na	na	20.8
1987[x,d]	2,452.5	180.3[aa]	7.4	na	na	23.7
1986[x,d]	2,038.1	213.0	10.5	na	na	20.6
Schering Group (West Germany)						
1989	$ 3,109.0	$119.7	3.9%	$244.1	$373.4	25.3
1988	2,995.5	89.2	3.0	233.5	358.0	24.7
1987	2,611.7	79.4	3.0	220.0	311.7	24.0
1986	2,148.4	65.0	3.0	117.4	253.9	23.9
Kemira (Finland)						
1989	$ 2,570.7	$ 40.9	1.6%	$374.1	na	16.0
1988	2,207.7	117.4	5.3	345.7	na	14.9
1987	1,942.7	64.4	3.3	644.8	na	13.8
1986	1,322.9	56.6	4.3	231.2	na	11.6

Note: All corporate consolidated sales exclude sales of companies owned less than 50%. a Excludes nonrecurring gain of $208.2 million. b Excludes nonrecurring loss of $78.3 million. c Excludes nonrecurring loss of $63.0 million. d Pro forma. e Net loss. f Excludes nonrecurring gain of $134.6 million. g Excludes nonrecurring gain of $9.5 million. h Fiscal year ends Sept. 30. i Excludes nonrecurring loss of $100.5 million. j Excludes nonrecurring loss of $136.5 million. k Excludes nonrecurring loss of $90.0 million. l Excludes nonrecurring loss of $83.3 million. m Excludes nonrecurring gain of $162.7 million. n Excludes nonrecurring loss of $87.9 million. o Excludes nonrecurring loss of $40.4 million. p Excludes nonrecurring loss of $22.4 million. q Excludes nonrecurring gain of $578.7 million. r Excludes nonrecurring gain of $17.6 million. s Excludes nonrecurring loss of $42.2 million. t Excludes nonrecurring loss of $8.2 million. u Excludes nonrecurring loss of $5.0 million and pretax write-off of $187.7 million. v Excludes nonrecurring gain of $17.8 million. w Excludes nonrecurring loss of $13.2 million. x Fiscal year ends March 31. y Excludes nonrecurring loss of $68.9 million. z Excludes nonrecurring gain of $218.9 million. aa Excludes nonrecurring loss of $19.7 million.

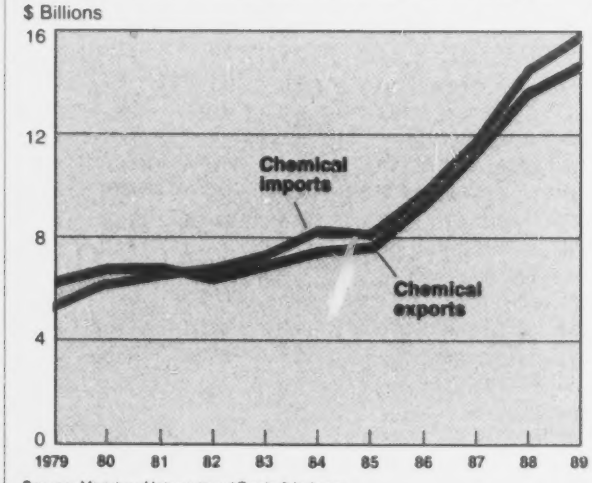
6 Foreign Chemical Industries—Japan

Japanese chemical companies, riding on a buoyant domestic economy, chalked up some impressive results last year. Measured in yen, sales by the chemical industry were up only 4%. Earnings, however, increased a hefty 28%.

The uptrend was particularly strong for petrochemicals, with ethylene output up 11% to 5.6 million metric tons, a new record. Impressive production gains also showed up among several products made from ethylene as well.

On the trade front, however, the record was no way near as rosy. Chemical exports rose 6% but imports increased nearly 8%, driving the country's chemical trade deficit well above the $1 billion level.

Japan's chemical trade deficit increases



Source: Ministry of International Trade & Industry

INDUSTRY TRENDS: Fertilizers continue to slip

Production index, 1985 = 100	1989	1988	1987	1986	Change 1988–89
All manufacturing	120.0	113.1	103.2	99.8	6%
All chemicals	128.0	120.4	111.1	103.2	6
Inorganic chemicals and pigments	114.4	108.4	100.9	98.5	6
Alkalies and chlorine	114.7	110.5	103.6	98.5	4
Organic chemicals	128.1	115.9	105.4	98.5	11
Petrochemicals	129.1	118.1	107.6	100.5	9
Aromatics	133.2	115.9	107.1	99.9	15
Cyclic intermediates and dyes	135.3	121.2	110.9	101.3	12
Plastics	130.7	120.6	109.9	102.5	8
Synthetic fibers	97.5	95.4	94.6	95.9	2
Synthetic rubber	116.7	112.2	102.9	99.6	4
Fertilizer	86.6	88.5	91.6	93.3	−2
Textile materials	118.7	117.8	110.7	103.1	1
Medicinals and drugs	145.0	136.2	123.1	108.8	6

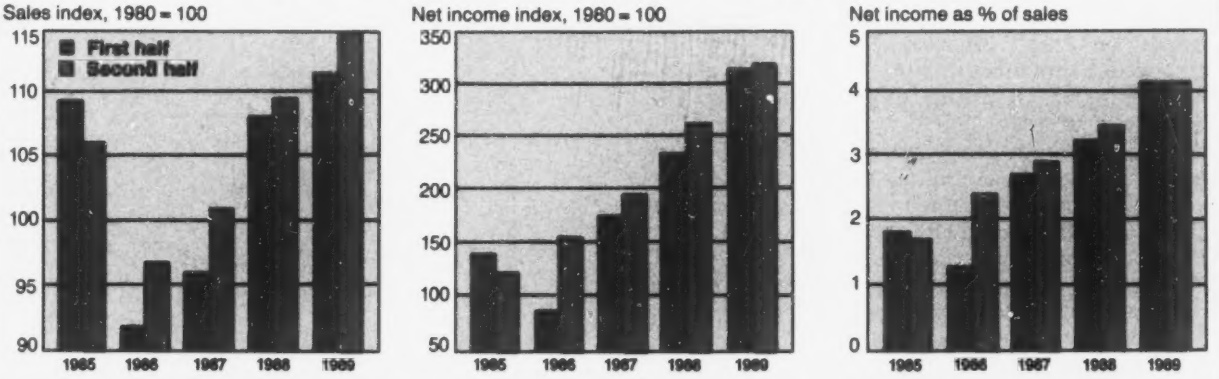
Source: Ministry of International Trade & Industry

PRODUCTION: Strong gains among organics

Thousands of metric tons, unless otherwise indicated	1989	1988	1987	1986	Change 1988–89
INORGANIC CHEMICALS					
Ammonia	1831	1817	1784	1794	1%
Ammonium chloride	274	299	332	364	−8
Ammonium sulfate	1717	1834	1804	1784	−6
Calcium carbide	344	342	354	399	1
Calcium superphosphate	454	476	499	514	−5
Carbon black	779	720	629	616	8
Chlorine, liquid	1009	979	911	881	3
Hydrochloric acid	571	565	543	549	1
Nitrogen, millions of cu m	7856	6940	6452	6293	13
Oxygen, millions of cu m	8384	7707	6878	6786	9
Sodium carbonate	1105	1083	1098	1022	2
Sodium hydroxide	3674	3508	3227	3077	5
Sodium silicate	756	721	664	603	5
Sulfuric acid	6885	6766	6541	6561	2
Titanium dioxide	275	258	238	223	7
ORGANIC CHEMICALS					
Acetaldehyde	356	333	285	254	7
Acetic acid	432	402	377	300	7
Acetone	337	289	260	228	17
Acrylonitrile	611	600	573	546	2
Benzene[a]	2672	2374	2226	2071	13
Butadiene	827	780	707	656	6
Butanol	291	276	259	248	5
Caprolactam	469	493	470	448	−5
Cyclohexane	656	561	557	515	17
Dioctyl phthalate	293	273	261	257	7
Ethylene	5602	5057	4585	4291	11
Ethylene dichloride	2464	2301	2051	1908	7
Ethylene glycol	548	349	313	339	57
Ethylene oxide	681	510	484	489	34
Methanol	82	141	181	221	−42
Octanol	285	273	257	235	4
Phenol	423	358	308	260	18
Phthalic anhydride[a]	160	171	172	163	−6
Propylene	4012	3682	3370	3167	9
Propylene glycol	285	265	236	223	8
Styrene	1990	1757	1559	1417	13
Terephthalic acid	1200	1150	1048	935	4
Toluene	1075	1019	1006	805	6
Toluene diisocyanate	104	96	91	86	8
Urea	810	790	729	778	3
Xylene	2488	1988	1767	1510	25
PLASTICS					
Phenolic resins	375	356	332	313	5
Polyethylene	2712	2380	2182	2066	14
Polypropylene	1719	1559	1406	1333	10
Polystyrene	1997	1891	1735	1598	6
Polyvinyl chloride	1972	1838	1663	1540	7
SYNTHETIC RUBBER	1352	1299	1192	1150	4

a Petroleum-based product only. Source: Ministry of International Trade & Industry

With sales up slightly but earnings strong, profitability is higher



Note: Based on results of 12 leading Japanese chemical companies: Asahi Chemical, Dainippon Ink & Chemicals, Hitachi Chemical, Mitsubishi Kasei, Mitsubishi Petrochemical, Mitsui Toatsu Chemicals, Sekisui Chemical, Showa Denko, Sumitomo Chemical, Takeda Chemical Industries, Teijin, and Toray Industries. The fiscal year for most, but not all, of these companies ends March 31. **Source:** Toyo Keizai Shinposha

COMPANY RESULTS: For Japanese chemical firms, profits generally are up and margins wider

$ Millions	Net sales	Net income	Profit margin	Total assets	Employees (thousands)
Asahi Chemical Industry[a]					
1989	$6377	$241.0	3.8%	$6468	15.1
1988	6384	219.4	3.4	6410	15.4
1987	5357	141.0	2.6	5241	15.6
1986	4351	84.6	1.9	4361	15.9
Mitsubishi Kasei[b]					
1989	$5307	$130.8	2.5%	$6621	8.9
1988	6132	124.9	2.0	6973	8.8
1987	4360	90.4	2.1	6002	8.9
1986	3775	42.0	1.1	5014	8.5
Sumitomo Chemical[c]					
1989	$4363	$145.7	3.3%	$5730	7.7
1988	4341	116.4	2.7	5806	7.7
1987	3609	78.6	2.2	4615	7.7
1986	3085	29.3	1.0	3949	7.6
Takeda Chemical Industries[a]					
1989	$4262	$271.7	6.4%	$5280	10.9
1988	4567	269.4	5.9	5358	10.8
1987	3777	219.6	5.8	4628	10.8
1986	2951	133.6	4.5	3599	10.8
Sekisui Chemical[a]					
1989	$4018	$171.6	4.3%	$3414	5.4
1988	3936	141.4	3.6	2919	5.2
1987	3089	84.6	2.7	2555	5.3
1986	2229	31.0	1.4	1782	6.3
Toray Industries[a]					
1989	$3982	$227.7	5.7%	$5362	9.6
1988	4317	134.7	3.1	5528	10.0
1987	3789	113.5	3.0	4854	10.6
1986	3250	67.1	2.1	3947	11.7

$ Millions	Net sales	Net income	Profit margin	Total assets	Employees (thousands)
Showa Denko[c]					
1989	$3811	$ 97.1	2.6%	$4455	5.1
1988	3679	71.3	1.9	4299	5.1
1987	2908	38.8	1.3	3881	5.0
1986	2116	22.1	1.0	3163	4.8
Dainippon Ink & Chemicals[a]					
1989	$3407	$ 62.4	1.8%	$3999	6.9
1988	3440	62.2	1.8	4074	6.7
1987	2923	43.7	1.5	3366	6.6
1986	2336	32.8	1.4	2214	6.3
Mitsui Toatsu Chemicals[a]					
1989	$2997	$ 87.3	2.9%	$3963	5.4
1988	3082	83.5	2.7	3936	5.4
1987	2543	43.5	1.7	3004	5.6
1986	2110	23.0	1.1	2599	5.6
Mitsubishi Petrochemical[a]					
1989	$2795	$227.8	8.2%	$4376	3.0
1988	2654	160.0	6.0	3493	2.9
1987	2022	64.7	3.2	2843	2.8
1986	1642	25.7	1.6	2073	2.5
Teijin[a]					
1989	$2217	$154.9	7.0%	$4015	5.7
1988	2438	136.5	5.6	3823	5.8
1987	2167	109.3	5.0	3391	6.2
1986	2039	72.0	3.5	2600	6.4
Hitachi Chemical[a]					
1989	$2023[d]	$ 29.7[d]	1.5%[d]	$1279	5.1
1988	2158	28.2	1.3	1261	5.0
1987	1748	20.7	1.2	1056	4.9
1986	1387	14.1	1.0	891	5.0

Note: Monetary statistics are converted from yen to U.S. dollars on the basis of $1.00 equals: 1989, 137.9 Y; 1988, 128.1 Y; 1987, 142.9 Y; 1986, 166.9 Y. Year-to-year changes in sales, net income, and assets are affected by these fluctuations in the currency exchange rate. a Fiscal year ends March 31. b Fiscal year ends March 31 for 1989 and 1988, Jan. 31 for 1987 and 1986. c Fiscal year ends Dec 31. d Estimated. **Sources:** Toyo Keizai Shinposha and Nihon Keizai Shimbon America Inc.

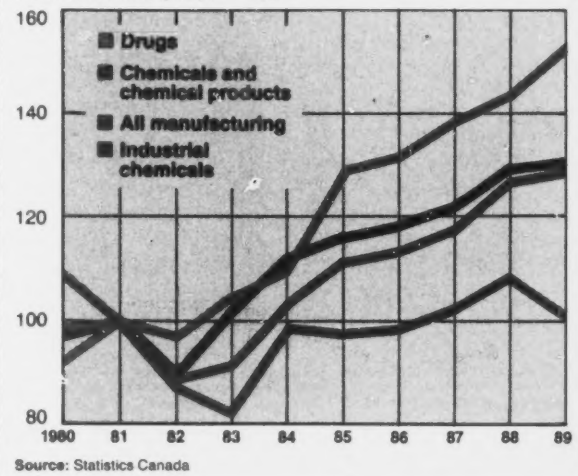
6 Foreign Chemical Industries—Canada

Exports declined and markets were weaker, as well, at home last year, resulting in lower production of many key petrochemicals and some inorganic chemicals in Canada. Coupled with weakness in chemical prices, these factors combined to make 1989 a year that, while still good by past standards, did not measure up to the banner year of 1988.

Canadian chemical companies' profitability felt the impact, as earnings sagged for all the country's major producers. Output was down for such key petrochemicals as ethylene, butadiene, benzene, and methanol. Even the major thermoplastics, which had racked up a long series of annual gains in production, suffered, with low-density polyethylene and polystyrene off 9%, for instance.

Moving into the 1990s, Canadian chemical companies still face many hurdles, not the least of which is an economy made more uncertain by a new Canadian sales tax and, especially, the constitutional impasse that has been threatening to split Quebec off from the rest of the nation.

Only drug output shows strong growth



Source: Statistics Canada

Note on currency conversion: Monetary statistics in this section have been converted from Canadian dollars to U.S. dollars on the basis of $1.00 U.S. equals: 1989, $1.184 Canadian; 1988, $1.231 Canadian; 1987, $1.322 Canadian; 1986, $1.391 Canadian; 1985, $1.362 Canadian; 1984, 1.308 Canadian.

COMPANY RESULTS: Mixed returns for 1989

$ Millions (U.S.)	Sales	Net income[a]	Profit margin	Capital expenditures	Employees (thousands)
Celanese Canada					
1989	$ 335.0	$ 40.8	12.2%	$ 14.5	1.9
1988	330.8	39.7	12.0	19.9	2.1
1987	265.5	21.5	8.1	16.1	2.1
1986	248.2	13.5	5.5	9.0	2.1
Du Pont Canada					
1989	$1196.9	$ 66.4	5.6%	$ 91.3	4.1
1988	1119.6	81.2	7.3	86.6	4.0
1987	1021.4	68.5	6.7	47.9	4.2
1986	893.7	43.4	4.9	67.9	4.6
Nova Corp. of Alberta					
1989	$4088.3	$157.1	3.8%	$621.7	13.0
1988	3202.1	321.8	10.0	356.7	11.3
1987	1755.4	170.1	9.7	151.2	7.0
1986	1927.6	96.3	5.0	234.4	6.8
Union Carbide Canada					
1989	$ 436.0	$ 36.0	8.3%	$ 41.7	2.6
1988	461.3	34.3	7.4	45.0	2.8
1987	318.4	19.4	6.1	26.2	2.3
1986	258.1	14.5	5.6	29.7	3.3

a Excludes extraordinary gains and losses.

PRODUCTION: Mostly down last year

Thousands of metric tons	1989	1988	1987	1986	Change 1988–89
INORGANIC CHEMICALS					
Ammonia	4054	4012	3512	3540	1%
Ammonium nitrate	1056	990	844	948	7
Ammonium phosphate	952	906	941	1149	−4
Carbon black	190	181	249	154	5
Chlorine	1592	1664	1635	1536	−4
Hydrochloric acid	180	180	164	153	0
Nitric acid	1027	919	900	1024	12
Phosphoric acid, 100% P_2O_5	470	475	464	554	−1
Sodium chlorate	593	503	432	373	18
Sodium hydroxide	1542	1720	1770	1696	−10
Sulfuric acid	3560	3805	3437	3536	−6
Zinc oxide	41	62	44	38	−35
ORGANIC CHEMICALS					
Benzene	670	695	720	635	−4
Butadiene	172	182	167	146	−6
Butylene	151	148	156	142	2
Ethylene	2317	2346	2140	1909	−1
Formaldehyde	120	123	122	117	−3
Methanol	2015	2101	1627	1403	−4
Propylene	719	672	628	628	7
Toluene	397	417	396	393	−1
Urea	2402	2372	2142	2330	1
Xylenes	432	399	345	356	8
PLASTICS					
Polyesters, unsaturated	37	43	47	37	−14
Polyethylene, high density	293	311	269	242	−6
Polyethylene, low density	1008	1105	1021	887	−9
Polystyrene[a]	196	216	197	186	−9

a Includes acrylonitrile-butadiene-styrene resins. Source: Statistics Canada

SHIPMENTS: Chemicals in general fall to keep pace with other industrial products

$ Millions (U.S.)	1989	1988	1987	1986	1985	1984	Change 1988–89[a]
All manufacturing	$250,849	$234,446	$203,013	$182,154	$182,526	$175,834	7%
Chemicals and chemical products	18,588	17,808	15,020	13,401	13,409	13,139	4
Industrial chemicals, inorganic	2,055	1,949	1,780	1,570	1,605	1,757	5
Industrial chemicals, organic	4,567	4,869	3,676	3,128	3,456	3,286	−6
Plastics and synthetic resins	2,165	2,034	1,681	1,488	1,445	1,395	6
Pharmaceuticals and medicinals	2,821	2,528	2,121	1,790	1,637	1,408	12
Adhesives	184	168	150	136	95	94	10
Paint and varnish	1,299	1,220	1,061	894	885	827	6
Soaps and cleansers	1,388	1,239	1,111	1,084	1,002	991	12
Toilet preparations	951	863	759	679	644	616	10
Printing ink	212	208	182	192	177	187	−2
Synthetic fibers	864	791	700	610	572	562	9
Plastic products	4,728	4,401	3,686	3,149	2,834	2,685	7

a In Canadian dollars. **Source:** Statistics Canada

CHEMICAL IMPORTS: Up sharply again

$ Millions (U.S.)	1989	1988	1987	1986
Inorganic chemicals	$1190	$ 910	$ 396	$ 377
Organic chemicals	1646	1559	1270	1163
Fertilizers and fertilizer materials	156	197	158	142
Synthetic and reclaimed rubber	232	228	202	169
Plastic materials	1238	1094	831	702
Plastic film and sheet	427	392	372	306
Other plastic shapes and forms	425	430	261	234
Dyes, except dyeing intermediates	96	86	71	58
Pigments, lakes, and toners	117	115	115	95
Paints and related products	233	195	176	132
Other chemical products	1155	951	857	823
TOTAL	**$6878**	**$6158**	**$4708**	**$4200**
Imports from U.S.	**$5060**	**$4330**	**$3609**	**$3145**
U.S. share	**74%**	**70%**	**77%**	**75%**

Source: Statistics Canada

CHEMICAL EXPORTS: Slightly lower

$ Millions (U.S.)	1989	1988	1987	1986
Chemical elements	$ 171	$ 198	$ 167	$ 173
Other inorganic chemicals	1112	1145	908	881
Organic chemicals	1542	1528	1029	822
Fertilizers and fertilizer materials	1237	1351	960	835
Synthetic rubber and plastic materials	1176	1276	859	631
Plastics, basic shapes and forms	404	383	380	327
Other chemical products	423	380	338	291
TOTAL	**$6063**	**$6262**	**$4639**	**$3961**
Exports to U.S.	**$4026**	**$3927**	**$2938**	**$2625**
U.S. share	**66%**	**63%**	**63%**	**66%**

Source: Statistics Canada

TRADE BALANCE: An unusual deficit . . .

$ Billions (U.S.)	1989	1988	1987	1986	1985
Total exports	$113.0	$109.3	$91.9	$83.9	$85.3
Total imports	114.1	107.0	87.9	81.3	77.1
Trade balance	−1.1	2.3	4.0	2.5	8.2

. . . as gap in chemical trade widens last year

$ Millions (U.S.)	1989	1988	1987	1986	1985
Chemical exports	$ 6063	$ 6262	$4639	$ 3961	$3988
Chemical imports	6878	6158	4708	4200	3997
Chemical trade balance	−815	−104	−69	−239	−9

Source: Statistics Canada

PRICES: Generally somewhat higher

Price index, 1981 = 100	1989	1988	1987	Change 1988–89
All commodities	131.1	128.1	122.8	2%
Chemicals and chemical products	134.8	132.3	120.4	2
Inorganic industrial chemicals	121.5	116.4	111.6	4
Sulfuric acid	135.9	133.6	130.6	2
Chlorine	130.3	130.8	130.4	0
Ammonia	75.7	79.6	78.9	−5
Organic industrial chemicals	116.8	117.0	95.0	0
Benzene-toluene-xylene	87.5	67.5	70.1	30
Olefins	116.9	114.9	79.5	2
Synthetic resins	133.8	141.1	118.0	−5
Polyethylene[a]	130.5	146.8	105.6	−11
Polystyrene	132.3	146.4	122.7	−10
Thermosets	138.0	133.0	116.1	4
Synthetic fibers	105.9	103.6	101.7	2
Agricultural chemicals	114.1	112.9	111.8	1
Mixed fertilizers	106.9	107.1	97.9	0
Pharmaceuticals	184.7	177.1	166.9	4
Paint and varnish	144.0	136.3	130.5	6
Soaps and cleansers	138.0	132.4	127.7	4
Toilet preparations	165.3	160.6	152.2	3
Pigments, lakes, and toners	126.4	126.8	120.2	0
Inks	113.1	112.4	110.7	1

a Includes both high and low density. **Source:** Statistics Canada

6 Foreign Chemical Industries—Eastern Europe

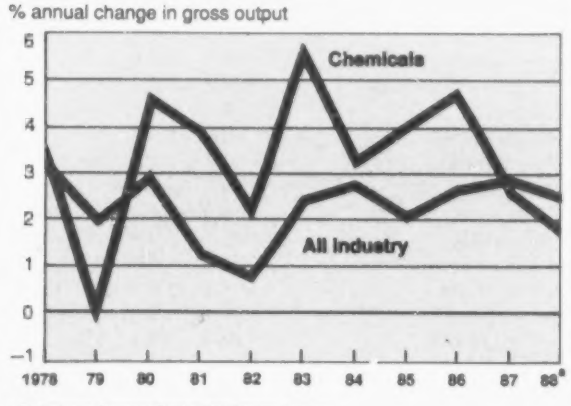
In 1989, amid political and economic upheaval in East Europe and the Soviet Union, industrial growth there decelerated sharply. Output rose just 1.3% for the region as a whole, according to official statistics, and fell 2% in Hungary and Poland. Output of chemicals also fell in those nations, as well as in Czechoslovakia. Soviet industrial output grew merely 1.7%, the lowest rate since 1950. And chemical production was up only 1.4%. The malaise continues, with Soviet industrial output down 1.2% in this year's first quarter.

MAN-MADE FIBERS: Soviet Union accounts for more than half of East Europe's total output

Production, thousands of metric tons	1988	1987	1986	1985	Change 1987–88
NONCELLULOSIC FIBERS[a]					
Bulgaria	90	88	86	71	2%
Czechoslovakia	140	135	132	115	4
East Germany	168	159	159	146	6
Hungary	26	24	24	23	10
Poland	140	137	132	137	3
Romania	203	202	200	197	1
U.S.S.R.	868	836	758	713	4
TOTAL	1635	1581	1491	1401	3%
CELLULOSIC FIBERS					
Bulgaria	28	33	42	42	−15%
Czechoslovakia	56	55	55	60	1
East Germany	161	157	158	168	3
Hungary	5	4	6	6	20
Poland	74	73	72	71	2
Romania	76	66	64	62	15
U.S.S.R.	601	592	589	586	2
TOTAL	1001	980	986	994	2%

a Excludes olefins and glass fiber. Source: Fiber Economics Bureau

Growth in industrial output slowed last year in Soviet Union



a Preliminary. Source: Central Intelligence Agency

PRODUCTION GROWTH: A slowdown hits East European industry in 1989

% annual change in gross output	1989	1988	1987	1986	1985
U.S.S.R. and East Europe					
All industry	1.3	3.8 %	3.7%	4.4%	3.6%
Bulgaria					
All industry	2.2	5.0	4.2	4.0	3.2
Chemicals	2.6	5.0	5.1	4.9	3.6
Czechoslovakia					
All industry	1.0	2.1	2.5	3.2	3.5
Chemicals	−0.2	1.9	3.2	4.0	5.1
East Germany					
All industry[a]	2.3	3.2	3.1	3.7	4.4
Chemicals	na	4.0	2.6	2.2	3.7
Hungary					
All industry	−2.0	−0.7	3.5	1.9	0.7
Chemicals[b]	−3.7	0.3	5.8	1.1	0.8
Poland					
All industry	−2.0	5.3	3.4	4.7	4.5
Chemicals	−1.1	6.5	4.3	4.2	3.0
Romania					
All industry	na	3.6	4.5	7.7	4.9
Chemicals	na	3.0	−4.1	8.3	0.3
U.S.S.R.					
All industry[c]	1.7	3.9	3.8	4.4	3.4
Chemicals[c]	1.4	3.8	4.4	6.3	5.0
All industry[d]	na	2.4[e]	2.9	2.7	2.0
Chemicals[d]	na	1.8[e]	2.6	4.8	4.1

a Industrial commodity production. b For state and cooperative industry only. c Figures based on official Soviet statistics. d Figures based on Central Intelligence Agency estimates, giving lower results because of postulated upward bias in official figures. e Preliminary figure. na = not available. Sources: United Nations Economic Commission for Europe and state central statistical bureaus, Central Intelligence Agency, PlanEcon Inc.

AGRICULTURAL CHEMICALS: Fertilizer supplies fall drastically in Soviet Union

Thousands of metric tons	1989	1988	1987	1986	1985
Bulgaria					
Fertilizer supply[a]	na	na	745	808	865
Pesticide supply[b]	na	na	28.5	36.5	35.6
Czechoslovakia					
Fertilizer supply[a,c]	na	1,595	1,562	1,780	1,714
East Germany					
Fertilizer supply[a]	na	1,805	1,664	1,642	1,639
Pesticide supply[b]	na	30.1	29.9	29.4	26.7
Hungary					
Fertilizer supply[a]	na	1,418	1,373	1,383	1,338
Poland					
Fertilizer supply[a,c]	3,690	3,277	3,583	3,413	3,280
Pesticide supply[b]	21.0	23.4	18.4	14.5	12.4
Romania					
Fertilizer supply[a]	1,200[d]	na	na	1,386	1,374
U.S.S.R.					
Fertilizer supply[a]	24,100	27,196	27,412	26,514	25,395
Nitrogen[a]	na	11,758	11,787	11,475	10,950
Phosphate[a,e]	na	8,556	8,564	8,354	7,615
Potassium[a]	na	7,044	7,052	6,677	6,822

a Nutrient content basis, as N, P_2O_5, or K_2O. b On basis of active substance. c For year ending June 30. d Approximate value. e Includes ground phosphate rock. na = not available. Sources: Department of Agriculture, Central Intelligence Agency, official national statistics from state central statistical bureaus

PRODUCTION: Output has stagnated for many major chemical products in East Europe

Thousands of metric tons, unless otherwise noted	1989	1988	1987	1986	1985
U.S.S.R.					
Sulfuric acid	28,300[a]	29,372	28,531	27,847	26,037
Mineral fertilizers[b]	34,300[a]	37,100	36,334	34,737	33,194
Nitrogen[b]	na	15,800	15,743	15,221	14,223
Phosphate[b,c]	na	10,000	9,693	9,279	8,596
Potassium[b]	na	11,300	10,888	10,228	10,367
Synthetic ammonia[d]	na	20,330	19,931	19,590	18,232
Plastics[e]	5,800[a]	5,672	5,488	5,345	5,019
Sodium hydroxide	3,200[a]	3,324	3,288	3,229	3,056
Ethylene	na	3,175	2,977	2,799	2,667
Methanol	na	3,211	3,284	3,219	2,850
Synthetic rubber[f]	na	2,485	2,366	2,320	2,125
Pesticides[g]	na	317	327	332	348
BULGARIA					
Sulfuric acid	770	780	689	807	810
Mineral fertilizers[b]	724	767	571	580	640
Nitrogen[b]	555	588	443	448	469
Phosphate[b]	169	178	128	132	172
Synthetic ammonia[d]	na	1,336	1,070	1,091	1,138
Plastics	na	363	322	420	406
Sodium hydroxide	113	129	104	138	151
Synthetic rubber	na	24	24	25	26
Pesticides[g]	18	15	15	15	18
CZECHOSLOVAKIA					
Sulfuric acid	1,142	1,249	1,264	1,292	1,297
Mineral fertilizers[b]	1,008	1,025	984	1,041	962
Nitrogen[b]	604	596	596	614	526
Phosphate[b,c]	296	313	277	307	310
Potassium[b,g]	108	116	111	120	126
Synthetic ammonia[d]	797	775	781	765	818
Plastics	1,186	1,180	1,152	1,140	1,103
Sodium hydroxide	337	337	344	347	332
Synthetic rubber	76	77	77	76	70
Pesticides[g]	18	19	18	19	19
EAST GERMANY					
Sulfuric acid	na	799	867	883	883
Mineral fertilizers[b]	na	5,192	5,118	5,046	4,842
Nitrogen[b]	na	1,383	1,317	1,252	1,078
Phosphate[b,c]	na	300	291	309	299
Potassium[b]	na	3,510	3,510	3,485	3,465
Synthetic ammonia[d]	na	1,160	1,179	1,197	1,210

Thousands of metric tons, unless otherwise noted	1989	1988	1987	1986	1985
Plastics	na	1,149	1,061	1,045	1,048
Sodium hydroxide	na	627	577	638	667
Synthetic rubber	na	104	99	120	158
Pesticides[g]	na	62	59	62	60
HUNGARY					
Sulfuric acid	482	512	573	540	520
Mineral fertilizers[b]	903	921	893	865	864
Nitrogen[b]	na	556	600	584	604
Phosphate[b]	na	228	177	163	130
Potassium[b,h]	na	137	116	118	130
Synthetic ammonia[d]	na	691	787	762	790
Plastics	634	590	545	426	389
Ethylene	262	264	270	269	271
Sodium hydroxide[i]	204	202	197	202	194
POLAND					
Sulfuric acid	na	3166	3149	2965	2863
Mineral fertilizers[b]	2727	2724	2622	2526	2270
Nitrogen[b]	1645	1622	1543	1445	1254
Phosphate[b]	945	962	942	948	889
Potassium[b,h]	137	140	137	133	127
Synthetic ammonia[d]	na	1923	1791	1747	1490
Plastics	723	720	641	632	603
Sodium hydroxide	na	444	422	427	414
Ethylene	na	328	276	279	261
Synthetic rubber	na	127	117	116	126
ROMANIA					
Sulfuric acid	na	na	1693	1971	1835
Mineral fertilizers[b]	2805	2994	2897	3278	3097
Nitrogen[b]	na	na	2080	2315	2197
Phosphate[b]	na	na	760	849	788
Synthetic ammonia[d]	na	na	2784	3037	2876
Plastics	na	654	638	664	628
Sodium hydroxide	na	na	817	846	814
Ethylene	na	na	319	312	307
Synthetic rubber	na	164	152	173	156
Pesticides[g]	na	na	41	53	53

a Approximate figures. b Nutrient content basis, as N, P_2O_5, or K_2O. c Including production of ground phosphate rock for direct applications and phosphate animal feeds. d Nitrogen content. e Including resins for man-made fibers. f Estimated. g On basis of active substance. h Imported potash added to domestically produced nitrogen and phosphate to form multinutrient fertilizer. i Including regenerated NaOH. na = not available. **Sources:** Central Intelligence Agency, Department of Agriculture, PlanEcon Inc., official national statistics from state central statistical bureaus

SOVIET FOREIGN TRADE: Rapid rise in imports switches balance from surplus to deficit

$ Millions	1989[a]	1988[a]	1987	1986	1985	1984	1983	1982	1981	1980	1979
Exports[b]	$111,361	$110,740	$107,664	$ 97,053	$87,196	$91,495	$91,652	$87,168	$ 79,380	$ 76,437	$ 64,912
Imports[b]	116,862	107,316	95,970	88,874	83,315	80,409	80,445	77,846	73,194	68,473	57,958
Trade balance	−5,501	3,424	11,695	8,179	3,881	11,086	11,207	9,322	6,186	7,964	6,954
Chemical exports[b]	na	na	2,979	2,770	2,837	2,707	2,307	2,203	2,275	2,025	1,606
Chemical imports[b]	na	na	4,516	3,990	3,774	3,256	3,216	3,028	3,211	3,275	2,803
Chemical trade balance	na	na	1,537	−1,220	−937	−549	−909	−825	−1,651	−1,250	−1,197

a Preliminary values. b Free on board. na = not available. **Sources:** Central Intelligence Agency, U.S.-U.S.S.R. Trade & Economic Council, based on official Soviet statistics and exchange rates

6 Foreign Chemical Industries—Western Pacific

SOUTH KOREA

INDUSTRY TRENDS: Chemical growth slows

Index, 1985 = 100	1989	1988	1987	1986	Change 1988–89
Chemicals, petroleum, coal, rubber, and plastic products					
Production	154.8	150.7	127.3	111.4	3%
Shipments	152.2	146.3	124.3	110.6	4
Inventories	155.4	128.5	114.0	109.9	21
Industrial chemicals					
Production	156.7	149.4	128.0	111.5	5
Shipments	151.6	146.1	128.2	113.6	4
Inventories	164.6	117.4	106.5	99.2	40
Other chemical products					
Production	182.8	171.2	132.6	108.0	7
Shipments	182.4	166.4	135.1	109.9	10
Inventories	195.4	159.5	122.5	114.0	23
Rubber products					
Production	128.1	151.1	140.0	122.6	−15
Shipments	128.1	150.9	139.2	121.3	−15
Inventories	123.1	131.2	119.4	114.4	−6
Plastic products					
Production	157.1	159.5	137.0	113.9	−2
Shipments	145.8	148.3	132.4	114.4	−2
Inventories	193.5	148.3	141.6	125.6	30
All manufacturing					
Production	170.5	166.1	145.9	121.9	3
Shipments	170.5	164.2	144.6	121.3	4
Inventories	161.6	137.6	120.6	108.6	17

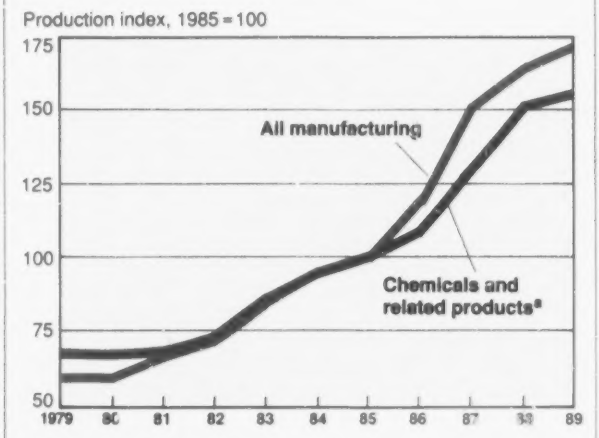
Source: Bureau of Statistics of the Korean Economic Planning Board

FOREIGN TRADE: Surplus shrinks markedly

$ Millions	1989	1988	1987	1986
Exports[a]	$ 62,377	$ 60,696	$ 47,281	$ 34,714
Imports[b]	61,465	51,811	41,020	31,584
Trade balance	912	8,886	6,261	3,130
Chemical exports[a,c]	2,050	1,879	1,321	1,068
Chemical imports[b,c]	7,158	6,282	4,595	3,495
Chemical trade balance	−5,108	−4,404	−3,274	−2,427

a Free on board. b Includes cost, insurance, freight. c Includes chemicals and related products. **Source:** Korean Office of Customs Administration

Surge in South Korea's industrial output eases a bit



a Includes petroleum, coal, rubber, and plastic products. **Source:** Bureau of Statistics of Korean Economic Planning Board

PRODUCTION: Plastics up but fertilizers down

Thousands of metric tons	1989	1988	1987	1986	Change 1988–89
Complex fertilizers	1985	2076	2026	1907	−4%
Urea fertilizers	888	1000	911	812	−11
Ethylene	663	609	576	534	9
Polyester fibers	654	593	496	426	10
Polyethylene	637	572	469	376	11
Polypropylene	530	518	348	263	2
Polystyrene	434	341	304	253	27
Polyvinyl chloride	464	455	451	472	2
Propylene	375	351	328	307	7
Benzene	305	308	339	301	−1
Sodium hydroxide	295	311	262	259	−5
Synthetic detergents	297	278	214	169	7

Source: Bureau of Statistics, Korean Economic Planning Board

AUSTRALIA

PRODUCTION: Growth stalls for plastics

Thousands of metric tons	1989[a]	1988[a]	1987[a]	1986[a]	Change 1988–89
Chemicals					
Hydrochloric acid, 100%	64	69	62	54	−8%
Nitric acid, 100%	na	204	203	193	na
Sulfuric acid, 100%	1904	1816	1678	1788	5
Ammonium sulfate	162	179	165	205	−10
Superphosphate[b]	3681	3194	2769	2610	15
Plastics and resins	986	990	904	885	0
Synthetic detergents	316	272	254	239	16
Unsupported plastics film, sheeting	185	188	174	162	−2
Polyethylene[c]	137	139	128	120	−2
Polyvinyl chloride[d]	15	16	16	15	−6

a Year ending June 30. b Includes double and triple superphosphates and ammonium phosphate expressed in terms of single phosphate (22% P_2O_5 equivalent). c Low and high density. d Including copolymers. na = not available. **Source:** Australian Bureau of Statistics

FOREIGN TRADE: Chemical imports up sharply

$ Millions	1989[a]	1988[a]	1987[a]	1986[a]
Exports[b,c]	$ 35,422	$ 29,935	$ 23,745	$ 22,936
Imports[d]	38,411	29,591	24,568	24,253
Trade balance	−2,989	344	−823	−1,317
Chemical exports[b,c]	861	650	440	414
Medicinal products	189	149	110	103
Chemical imports[d]	4,045	3,118	2,304	2,116
Organic chemicals	951	806	584	536
Medicinal products	566	472	337	275
Chemical trade balance	−3,184	−2,468	−1,864	−1,702

Note: Monetary statistics converted from Australian to U.S. dollars on basis of $A1.00 equals: 1986, $0.6996; 1987, $0.6636; 1988, $0.7290; 1989, $0.8160. a Year ending June 30. b Free on board. c Includes reexports. d Values for customs purposes, free-on-board basis. **Sources:** Australian Department of Foreign Affairs & Trade, Reserve Bank of Australia

6 Foreign Chemical Industries—Eastern Asia

CHINA

PRODUCTION: Expansion continues, with plastics and fibers setting the pace last year

Thousands of metric tons, unless otherwise noted	1989	1988	1987	1986	Change 1988–89
Synthetic ammonia	20,675	19,725	19,486	17,195	5%
Fertilizer[a]	18,547	17,670	17,033	13,966	5
Sulfuric acid	11,408	10,981	9,620	7,631	4
Sodium hydroxide	3,212	2,925	2,735	2,270	10
Sodium carbonate	2,983	2,593	2,372	2,150	15
Plastics	1,973	1,552	1,571	1,322	27

Thousands of metric tons, unless otherwise noted	1989	1988	1987	1986	Change 1988–89
Man-made fibers	1,466	1,284	1,157	1,016	14
Synthetic detergents	1,380[b]	1,290	1,192	1,150	7
Ethylene	1,405	1,231	839	642	14
Pesticides	224	202	157	223	11
Pharmaceuticals	196	194	154	107	1
Rubber tires[c]	31,586	29,256	23,328	19,236	8

a Nutrient content. b Estimated. c In thousands of units, not including aircraft and bicycle tires. na = not available. **Sources:** State Statistical Bureau of the People's Republic of China, *China Daily*, *China Economic News*, Central Intelligence Agency

CHEMICAL IMPORTS: Large drop in 1989

$ Millions[a]	1989	1988	1987	Change 1988–89
Organic chemicals	$1405	$1701	$ 998	−17%
Inorganic chemicals	469	448	422	5
Dyeing, tanning, coloring materials	226	237	202	−4
Medicinal and pharmaceutical products	311	384	229	−19
Fertilizers[b]	2364	2335	1399	1
Plastic materials, resins, cellulose esters and ethers	2206	3558	1470	−38
TOTAL	$7556	$9139	$5008	−17%

a Includes cost, insurance, and freight. b Manufactured. **Source:** General Administration of Customs of the People's Republic of China

CHEMICAL EXPORTS: Further increase

$ Millions[a]	1989	1988	1987	Change 1988–89
Organic chemicals	$ 690	$ 575	$ 500	20%
Inorganic chemicals	794	762	553	4
Dyeing, tanning, coloring materials	288	229	175	26
Medicinal and pharmaceutical products	549	466	408	17
Essential oils, perfumes, cleansing materials	235	183	136	29
Explosives, pyrotechnic products	244	298	183	−18
TOTAL	$3201	$2897	$2235	10%

a Free on board. **Source:** General Administration of Customs of the People's Republic of China

TAIWAN

INDUSTRY TRENDS: Petrochemicals falter

Industrial production indexes, 1986 = 100	1989	1988	1987	1986	Change 1988–89
All manufacturing	119.3	115.4	111.2	100.0	3%
Chemical materials	110.3	108.0	103.6	100.0	2
Basic chemicals	102.9	94.4	96.5	100.0	9
Petrochemicals	92.9	98.8	97.1	100.0	−6
Fertilizers	111.3	113.4	102.9	100.0	−2
Synthetic fibers	126.7	113.5	109.7	100.0	12
Plastics and resins	126.1	122.8	110.6	100.0	−3
Chemical products	129.1	125.7	114.8	100.0	3

Source: Taiwan Ministry of Economic Affairs

FOREIGN TRADE: Chemical deficit lower

$ Millions	1989	1988	1987	1986
Exports[a]	$ 66,205	$ 60,585	$ 53,612	$ 39,849
Imports[b]	52,267	49,656	34,957	24,165
Trade balance	13,938	10,929	18,655	15,684
Chemical exports[a,c]	5,397	4,844	3,741	2,743
Chemical imports[b,c]	7,410	7,051	5,150	3,870
Chemical trade balance	−2,013	−2,207	−1,409	−1,127

Note: Statistics converted from NT$ to U.S. dollars on basis of $1.00 equals: 1989, NT$26.4; 1988, NT$28.6; 1987, NT$31.8; 1986, NT$37.9. a Free on board. b Includes cost, insurance, and freight. c Includes chemicals, chemical products and plastic and rubber products. **Sources:** Taiwan Council for Economic Planning & Development, Taiwan Ministry of Finance Department of Statistics, C&EN estimates

PRODUCTION: Down for several top chemicals

Thousands of metric tons, unless otherwise noted	1989	1988	1987	1986	Change 1988–89
Polyester[a]	1193	1235	1076	941	−3%
Sulfuric acid	768	664	742	727	16
Ethylene	766	852	823	868	−10
Polyvinyl chloride	805	779	773	724	3
Vinyl chloride	662	708	699	668	−6
Ammonium sulfate	524	484	485	604	8
Compound fertilizer	488	470	420	371	4
Ammonia, anhydrous	246	339	296	323	−27
Sodium hydroxide	186	331	325	366	−44
Hydrochloric acid	217	255	251	242	−15
Urea	237	306	244	214	−23
Calcium superphosphate	352	315	342	336	12
Ethylene glycol	216	197	195	219	9
Oxygen[b]	352	350	261	262	1
Polyethylene	344	390	375	400	−12
Acrylonitrile-butadiene-styrene	311	301	208	151	3
Paints	214	247	229	184	−13
Dioctyl lactam	179	167	192	185	7
Styrene	301	331	310	243	−9
Acrylonitrile	132	144	125	150	−8

a Filament and Fiber. b Millions of cubic meters. **Sources:** Taiwan Council for Economic Planning & Development